ECO Solutions, Inc.

HOECHST CELANESE
CHEMICAL GROUP, INC.
Bay City Plant

WORKOVER AND MECHANICAL INTEGRITY TESING ON WDW-49 (WELL NO. 4)

Prepared by:

ECO Solutions, Inc.
10333 Richmond Ave., Ste. 250
Houston, Texas 77042

May 1994

Job No. 94004

Hoechst Celanese

Chemical Group
Hoechst Celanese Corporation
Bay City Plant
PO Box 509
Highway 3057
Bay City TX 77404-0509

May 9, 1994
IOC-043-94

FEDERAL EXPRESS MAIL - 8635790590

Mr. Ben K. Knape - Head
UIC Team
UIC, Uranium and Radioactive Waste Section
Industrial and Hazardous Waste Division
Texas Natural Resource Conservation Commission
P. O. Box 13087
1700 North Congress Avenue
Austin, Texas 78711-3087

Subject: WDW-49 (PLANT WELL NUMBER 4)
WORKOVER AND MECHANICAL INTEGRITY TESTING REPORT
HOECHST CELANESE CHEMICAL GROUP, INC.
BAY CITY PLANT, BAY CITY, TEXAS

Dear Mr. Knape:

Two copies of the Workover and Mechanical Intergity Testing report on WDW-49 are enclosed. These reports are provided for your review and approval. As you are aware, the workover and mechanical integrity testing were performed between March 3rd and March 18, 1994 by our Contractor, ECO Solutions, Inc.

Please contact me at 409/241-4197 or Mr. Ray Horton at 409/241-4076 if you have comments or questions about the report.

Very truly yours,

I. O. Coleman, Jr.

I. O. Coleman, Jr.

RECEIVED
MAY 10 1994
6 W-SU

cc: Mr. Laurence G. Walker - w/o report
UIC Team
Industrial and Hazardous Waste Division
Texas Natural Resource Conservation Commission
P. O. Box 13087
Austin, Texas 78711-3087

Mr. Phil Dellinger (CERTIFIED MAIL) - w/ report
Underground Injection Control Program
Environmental Protection Agency
1445 Ross Avenue, Suite #1200
Dallas, Texas 75202-2733

Hoechst

ECO SOLUTIONS, INC.
One North Park East, Suite 220
8950 N. Central Expressway, Dallas, TX 75231
214-373-0065
FAX 214-696-2622

ECO Job No. 94004

Friday, May 6, 1994

Sent Via Federal Express

I. O. Coleman
Hoechst Celanese Chemical Group, Inc.
P.O. Box 509
FM 3057
Bay City, TX 77404-0509

RE: Final Report of WDW-49 Workover and Mechanical Integrity Test Report

Dear Mr. Coleman:

You will find enclosed seven (7) copies of the above referenced report on Waste Disposal Well No. 49 (Well No. 4). This final report includes all figures and appendices that will go to the TNRCC.

This final report is past the 30 working day time limit for submittal of reports to the TNRCC. ECO Solutions experienced delays completing this report due to 1) awaiting final copies of the MIT logs, and service company evaluations of these same logs, 2) delays receiving the final analysis report and data from the falloff test report, and 3) lag time reviewing drafts of the final report. These circumstances were outside of ECO Solution's control, but we must accept responsibility for any delays submitting this final report to the TNRCC.

Thank you for the opportunity to be of service to Hoechst Celanese Chemical Group. Should you have any questions, please feel free to call me at 214-373-0065.

Sincerely,

ECO SOLUTIONS, INC.

Randy W. Ireland

Randy W. Ireland
VP and Dallas General Manager

cc: Thomas A. Jones (ECO - Houston)
Robert M. Hall (ECO - Houston)

attachments
94004CV2.WPD

ECO Solutions, Inc.

HOECHST CELANESE CHEMICAL GROUP, INC.
Bay City Plant

WORKOVER AND MECHANICAL INTEGRITY TESING ON WDW-49 (WELL NO. 4)

Prepared by:

ECO Solutions, Inc.
10333 Richmond Ave., Ste. 250
Houston, Texas 77042

May 1994

Job No. 94004

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APPENDICES

1.0 INTRODUCTION AND EXECUTIVE SUMMARY

1.1 INTRODUCTION

Hoechst Celanese Chemical Group, Inc. (HCCG) contracted ECO Solutions, Inc. (ECO) to workover WDW-49 (Well No. 4) and perform pressure falloff and mechanical integrity testing at Hoechst Celanese Chemical Group's Bay City Plant in Matagorda County, Texas. Workover and mechanical integrity testing operations were supervised by ECO Solutions' Robert M. (Bob) Hall. Workover operations commenced on Thursday, March 3, 1994, and ended on Friday, March 11, 1994. Pressure falloff testing was supervised by ECO Solutions' Reuben L. Alaniz. Falloff testing commenced on Monday, March 14, 1994, and ended on Friday, March 18, 1994. Daily activities are detailed in Section 1.2.

The workover was conducted to replace the injection tubing due to a leak. The tubing was successfully replaced, and the well was placed back in service on Tuesday, March 8, 1994. Mechanical Integrity Testing (MIT) consisted of a Magnelog Casing Inspection Survey that was performed in conjunction with the workover. Annulus Pressure Tests (APT) and Radioactive Tracer (RAT) surveys were performed after completion of the workover. The MIT was successfully completed on Friday, March 11, 1994.

1.2 WORKOVER SUMMARY

The workover on WDW-49 commenced on Thursday, March 3, 1994, with the move in and rig up of Dawson-Welltech's workover rig. The 5 1/2" 20 pounds per foot (ppf) injection string was pulled from the well. Atlas Wireline was rigged up and a Magnelog casing inspection was run from 3,308' to the surface. No anomalies were noted during the Magnelog inspection run.

A seal assembly and workstring were run in the hole, stung into the packer, and the annulus filled with brine. Field operations conducted an annulus pressure test (APT) to 1,018 psig with a 2 7/8" workstring in the hole. Annulus pressure decreased only 10 psi in thirty (30) minutes. The workstring was pulled from the hole and the new 5 1/2" 20 ppf injection string was run in the hole.

After the new injection string was installed, an annulus pressure test was performed. During the first annulus pressure test, a leak was noted in the surface test equipment. The wellhead was installed, the annulus was pressured to 1,000 psig, and the wellhead was found to be leaking. The wellhead leak was repaired and the annulus pressured up to 1,006 psig. Annulus pressure decreased to 908 psig in thirty minutes on this third APT. The well was closed in for the night and allowed to stabilize.

The following morning, the annulus was pressured up to 1012 psig, with a subsequent decrease to 900 psig in thirty minutes. The TNRCC inspector arrived on site and was informed of the test results. The formal test was aborted. On a final attempt, the annulus was repressured to 1,014 psig and decreased to 953 psig in thirty minutes.

The workover rig was rigged back up and the wellhead nippled down. The rig picked up the injection string, pulled the seal assembly out of the packer bore, rotated the injection string 1/2 rotation to the right, and reseated the packer. The same day, the annulus was pressured up to 1,014 psig and bled to 953 psi in thirty minutes. The well was closed in for the night and allowed to stabilize.

On Thursday, March 10, 1994 the annulus was again pressured up to 1,118 psig and monitored for 140 minutes. The pressure did not decrease during this period. The pressure was bled to 400 psig, then increased to 1,042 psig, and monitored for 90 minutes. No pressure losses were noted. WDW-49 successfully passed the APT on Thursday, March 10, 1994.

2.0 DAILY ACTIVITIES

2.1 REPLACE INJECTION STRING

Thursday, March 3, 1994

All contractors attended HCCG safety orientation and site specific safety training. Laid down 8 mil plastic liner beneath workover rig. Spotted pump, tanks, and pipe racks. Moved in and rigged up Dawson-Welltech workover rig. Unloaded 20 barrels of 9.8 ppg brine from B&G Well Service. Unloaded workstring and miscellaneous rental equipment.

HCCG personnel measured remaining wall thickness on 5 1/2" 20 ppf, N-80 injection string exposed above the wellhead at 0.300" and checked around two (2) weld areas for potential cracks prior to picking up on injection string.

Removed threaded valve assembly from threaded socket weld on injection string in preparation of picking up string. Threads on socket weld were severely corroded. Decision made to wait until morning prior to picking up on injection string. Made contingency plans for potential "parting" of the injection tubing above the wellhead in either the threaded area or the pipe body.

Friday, March 4, 1994

Picked up on 5 1/2" injection string. String free to move in wellhead. Unscrewed wellhead and attempted to "strip" same off wellhead. Welded plate on 5 1/2" injection string prevented wellhead removal. HCCG personnel cut the plate off. Removal of wellhead exposed a circumference crack exposed in 5 1/2" injection tubing. Stripped off wellhead. HCCG welder welded bead beneath cracked area.

Picked up set of 5 1/2" slip type elevators and set same beneath welded bead. Picked up on injection string and pulled out of TIW "S" packer. Pulled one (1) joint of 5 1/2" injection tubing. Installed annular BOP. Rigged up Weatherford International casing tongs. Started out of the hole with 55 joints 5 1/2" injection tubing. Closed well in for night.

Saturday, March 5, 1994

Finished pulling out of hole with injection string and TIW seal assembly. Rigged down Weatherford International.

Rigged up Western Atlas to run Magnelog Casing Inspection Survey. Went in hole with same to the top of the injection packer at 3,308' (logged depth). Pulled out of the hole logging. No anomalies noted. Rigged down and released Western Atlas.

Picked up test seal assembly and 2 7/8" PH-6 workstring. Went in hole with same. Stung into packer and filled annulus with brine. Closed well in until Monday, March 7, 1994

Monday, March 7, 1994

Pressure tested 7 5/8" protection casing to 1,018 psig. Pressure decreased 10 psi in thirty (30) minutes (0.33 psi/min). Test successful.

Pulled out of hole laying down 2 7/8" PH-6 workstring and test seal assembly. Unloaded 83 joints of new 5 1/2" 20 ppf, N-80 LT&C tubing.

Rigged up Weatherford International casing tongs and computerized thread makeup unit. Started in hole with redressed TIW "S" seal assembly (Chevron seals) and 49 joints of 5 1/2" tubing. Displaced annulus with 100 bbls of Halliburton Anhib inhibited brine prior to closing well in for night.

Tuesday, March 8, 1994

Finished in hole with 5 1/2" 20 ppf, N-80 LT&C injection string (79 joints total). Stung into "S" packer at 3,316' with 25,000# weight down on packer. See 5 1/2" injection tubing tally in Appendix A.

Pressure tested annulus to 1,000 psi for fifteen (15) minutes. Pressure decreased approximately 1 psi/minute with a small leak noted in the surface equipment. Texas Natural Resource Conservation Commission (TNRCC) allowable leakoff rate is 50 psi in 30 minutes (1.67 psi/min).

Rigged down Weatherford International and casing tools. Installed new wellhead. Rigged down workover rig and peripheral equipment and moved off location to make room for HCCG personnel working on wellhead. HCCG welder cut off extended section of 5 1/2" tubing exposed above the wellhead and welded on 5 1/2" 8 round threaded slip on weld nipple.

Pressure tested annulus to 1,000 psig. Wellhead leaking in lower thread area of 8 5/8" x 7 5/8" carbon steel adapter. Welded bead around same to stop leak. Repressurized annulus to 1,006 psig. Pressure decreased to 908 psi in 30 minutes (3.07 psi/min). Will allow well to stabilize overnight prior to retesting. Closed well in for night.

Wednesday, March 9, 1994

Repressured annulus to 1,012 psig. Pressure decreased 112 psi to 900 psig in 30 minutes (3.73 psi/min). Notified Larry Walker upon arrival (TNRCC inspector) of annulus pressure test results. Aborted formal TNRCC annulus pressure test.

Repressured annulus to 1,108 psig. Pressure decreased 83 psi in 30 minutes (2.77 psi/min) to 1,025 psig. Discussed plan of action with HCCG personnel. Decision made to remove TIW seal assembly from "S" packer bore and allow the differential pressure/flow from the annulus to the tubing "wash" across the seals on the TIW seal assembly.

Rigged up workover rig. Nippled down wellhead and picked up injection string with 25,000# weight on packer. Pulled seal assembly out of packer bore, rotated the injection string 1/2 rotation to the right and reseated injection string with 20,000# weight down on packer. Nippled up wellhead.

Filled annulus with 8 bbls of inhibited brine. Repressured annulus to 1,014 psig. Pressure decreased 61 psi to 953 psi in 30 minutes (2.03 psi/min). Bled pressure to 100 psig. Closed well in for night.

Thursday, March 10, 1994

Repressured annulus to 1,118 psig, pressure decreased 0 psi over 140 minute period. Cycled annulus pressure - bled pressure to approximately 400 psig and then increased pressure back up to 1,042 psig. Pressure held at 1,042 psig over 90 minute period.

HCCG personnel connected the annulus pressure instrumentation and monitored the annulus pressure for several hours. No pressure decrease was noted during this time. Bled pressure to 550 psig. Closed well in for night.

Friday, March 11, 1994

Moved in and rigged up Atlas Wireline Services. Ran in hole to 3,433'. Ran Radioactive Tracer (RAT) Survey. Rigged down Atlas Wireline Services. Returned well to service.

2.2 PRESSURE FALLOFF TESTING

Tuesday, March 15, 1994

0700 Milton Cooke Wireline on location, check in with front gate. Spot equipment and begin rigging up on WDW-49 (Well #4).

0815 Meet with Ray Horton, review test procedures and current injection conditions of all wells. WDW-110 (Well #1A) out of service on Friday, March 11, 1994. WDW- 14 (Well #2) out of service on Friday, February 18, 1994, and WDW- 32 (Well #3) out of service on Friday, March 11, 1994. WDW- 49 (Well #4) maintain constant rate on Friday, March 11, 1994.

1000 Review instructions with Milton Cooke for programming back-up memory gauge.

1045 Milton Cooke checking CCL and cable counter.

1210 Pressure up lubricator with Surface Read Out and Memory Gauge tool string. Prepare to go in hole.

1218 Going in hole with well injecting. Injection Rate is 162 gpm, and Surface Injection Pressure is 464 psig.

1310 Gauge at 3200 ft , begin logging with collar locator, tying into packer at 3316 ft.

1400 Having trouble with GRC data acquisition system.

1422 Set tool string at 3300 ft , waiting for new GRC acquisition system.

1715 Begin GRC Data Acquisition System with GRC EPG-520 gauge (S/N 69491).

1731 Pull gauge up hole and set at 3000 ft, monitor bottom hole injection pressure and temperature.

1800 Continue monitoring injection period. Injection Rate is 164 gpm, Down hole Injection Pressure is 1760 psia, and Surface Injection Pressure is 462 psig.

Wednesday, March 16, 1994

0700 Continue monitoring injection period. Injection Rate is 166 gpm, Down hole Injection Pressure is 1760 psia, and Surface Injection Pressure is 460 psig. Generated Cartesian curve to evaluate pressure stability. Prepared for falloff test.

1200 Rate and pressure increase, speak with operator for possible cause.

1300 Operator re-adjusting rate, possible trouble with motor valve.

2258 Still experiencing motor valve problems, causing rate and pressure fluctuations.

Thursday, March 17, 1994

0600 Monitoring injection period. Injection Rate is 168 gpm, Down hole Injection Pressure is 1758 psia, and Surface Injection Pressure is 460 psig. Flow rate and bottom hole pressure stabilized. Prepare for falloff test.

0707 Injection Rate is 168 gpm, Down hole Injection Pressure is 1758 psia, and Surface Injection Pressure is 460 psig. Shut down Injection pump at Control room 1. Begin Falloff test.

1200 Monitoring falloff period. Down hole Shut-in Pressure is 1384 psia and Surface Shut-in Pressure is 90 psig.

1700 Continue monitoring falloff period. Down hole Shut-in Pressure is 1383 psia and Surface Shut-in Pressure is 88 psig.

Friday, March 18, 1994

0800 Generate Semi-Log and Log-Log curves for observation. Pressure derivative curve and semi-log curves indicates radial flow period has been obtained. End falloff test. Down hole Shut-in Pressure is 1381 psia, and Surface Shut-in Pressure is 80 psig.

0821 Drop tool 10 ft down hole. Begin pulling out of hole making static gradient stops.

1000 Gauges at surface, end of static gradient survey. Bleed down lubricator. Rig up weight bars and collar locator, go back in hole to tag bottom.

1030 Release WDW-110 (Well #1-A) over to plant for operation. Injection falloff test scheduled for March 21, 1994.

1105 Tag bottom at 3423 feet. Pull out of hole, rig down and move equipment over to WDW-110 (Well #1-A).

3.0 PRESSURE FALLOFF TESTING

3.1 PRESSURE FALLOFF TESTING

Pressure falloff testing commenced on Tuesday, March 15, 1994 and concluded on Friday, March 18, 1994. The flowing bottom hole pressure was monitored for a total of 37.87 hours followed by a 24.88 hour shut-in period. Plots and data for the test are included in Appendix E. The period of last shut-in was March 11 to 15, 1994 and a graphic presentation of injection versus days for this 95 hour period is included in Appendix E.

3.2 PRESSURE FALLOFF ANALYSIS

Method Of Interpretation: The following analysis was performed by utilizing both Semi-Log and Log-Log analysis. A) The *Semi-Log* curve was generated by plotting pressure vs. the superposition time function utilizing the given rate history. The semi-log straight line was then calculated by linear regression through the infinite acting flow period of the falloff curve. The semi-log slope and P_{1hr} values were obtained from the semi-log straight line and utilized for the final permeability and skin calculations. B) The *Log-Log* curves were generated by plotting Delta-P/Delta-Q and Pressure derivative vs. the Agarwal Equivalent time function. The Log-Log curves were simultaneously positioned over $[T_D/C_D]$ wellbore storage type-curves until a solution match was obtained. Permeability and skin values were calculated from this match and then compared with those obtained from the Semi-Log analysis.

A. *Semi-Log (Superposition)*: The straight line area of the semi-log curve was identified by first using the 1-1/2 log cycle rule to estimate the end of wellbore storage effects. Secondly, the time of the flat portion from the pressure derivative curve was used in determining the area of the semi-log curve in which the straight line was drawn. The semi-log straight line yielded a slope value of 5.5174 psi/cycle and a P_{1hr} of 1388 psi. The pressure difference between P_{1hr} and the injection pressure followed with the calculated slope give indications of positive skin damage and high permeability.

B. *Log-Log ($[T_D/C_D]$ Wellbore storage Type-curves)*: The high maximum of the derivative curve illustrates wellbore storage and positive skin effects. The flattening portion of the derivative indicating the infinite acting flow period of the curve was observed approximately 5.3 hours following the start time of the falloff period. The flat portion of the derivative curve was the main factor used to obtain a type curve match yielding similar results to the semi-log analysis.

Conclusions: The system was diagnosed as a homogeneous reservoir with a calculated permeability of 1417 (md) and skin damage of +69.8 utilizing an h_{net} value of 85 feet. The flow efficiency of 12.3% suggests that the near wellbore condition impacts the injection volume limitations and the total pressure drop is primarily due to conditions within a small radius from the well.

The Following Table is provided to give comparative results with the previous test. The primary variables affecting the calculated results are included.

Date MM/YY	Rate GPM	h_{net} feet	Uw cp	Slope psi/cyl	kh/u md-ft	k md	S -
09/92	79.5	85	0.710	2.710	163,584	1366.4	+ 117.0
03/94	168.0	85	0.710	5.5174	169,620	1416.8	+ 69.8

The calculated results indicate a difference in transmissibility, (kh/u) of 3.6% and a difference in skin of 40.3% between the two tests. The decrease in skin could be contributed to the fact the well was inactive for several months and installation of a new injection string since the previous well test. The transmissibility and permeability values are fairly consistent between the two tests. The primary conclusion is there has been no significant change in reservoir conditions.

The time to exit the waste front was less than the start time of the infinite acting flow period. Therefore, the viscosity of the original reservoir fluid was used for the final analysis.

A homogeneous simulator was utilized to confirm the calculated results mentioned above. The main assumptions were as follows: 1) a single well with infinite acting and radial flow conditions, 2) injection at a constant rate, and 3) constant reservoir conditions such as porosity, permeability, and compressibility. Based on this particular reservoir the simulated data matched the actual data with a reasonable degree of accuracy. The program used for final analysis and well simulation was "PanSystem 2.1", marketed by Edinburgh Petroleum Services. Plots of the analysis using the "PanSystem 21" are included in Appendix E.

Table 3.1 Falloff Test Data

1. *General Test Information*

Date of Test	March 15 - 18, 1994
Cumulative injection (gals.)	1846.49 x 10^6 gallons
Wellbore radius (ft.)	0.458
Gross completed interval (ft.)	3372' -3579'
Type of completion	Slotted Screen Gravel Pack in Open Hole
Depth to fill	3423'
Justified interval thickness (ft.)	85'
Average historical waste fluid viscosity (cps)	0.5914 at 120 °F
Formation fluid viscosity (cps)	0.71 at 120 °F
Porosity (%)	33
Total compressibility (psi^{-1})	$5.0x10^{-6}$
Formation volume factor	1.0
Initial formation bottom hole pressure (psia)	1501 (1968) @ 3,300'

2. *Injection Period*

Time of injection period (hrs.)	95
Injection rate (gallons per minute)	168
Test fluid	Waste Fluid
Pumps used for test	P61 Byron Jackson - Centrifugal
Injection fluid viscosity (cps)	0.5914 at 120 °F
Final injection pressure (psia)	1758.40
Final injection temperature (°F)	81.87
Gauge type	GRC EPG-520 Serial # 69491
Gauge resolution and calibration	0.01 psi
Gauge depth (feet)	3000

3. *Falloff Period*

Total Shut-in Time (hrs.)	24.88
Final Shut-in Pressure (psia)	1380.76
Final Shut-in Temperature °F	97.52
Final Shut-in Tubing Pressure (psia)	80

Table 3.2 Analysis Results of Pressure Falloff Test

	Log-Log Type Curve	Semi-Log Synthesis
kh/m (md-ft/cp)	201,217.5	203,636.0
Flow capacity (md-ft)	119,000	120,430.3
Permeability (md)	1,400	1,416.8
Skin effect	69	69.76
Dimensionless storage coefficient		0.06
p* (psia)	1,376.4347	1,377.2898

3.3 COMPARISON TO PETITION MODEL DATA

The reservoir properties (pressure, permeability, etc.) of the upper Miocene injection interval were determined through falloff testing conducted on WDW-49. The flowing or operational formation pressures from the tests can be compared with the modeled operational pressures by converting the measured pressures to a depth of 3440' below ground level and removing the pressure increase due to skin effect. A fluid gradient of 0.434 psi/ft was used to correct all pressures from the gauge depth of 3000' to 3440'. The formation pressures predicted by the model assume no formation damage effects or other near-wellbore conditions. The measured flowing pressures corrected for skin effects and maximum predicted operational pressures are presented in the Table below:

Formation Pressures

WDW-49 (Well 4) Depth	Flowing Formation Pressures, psi	Skin Pressure Loss, psi	Revised Formation Pressure, psi	Maximum Modeled Pressure, psi
3000'	1758	334	1424	NA
3440'	1949	334	1615	1640

The measured flowing pressure is below the maximum modeled operational pressure by 25 psi for WDW-49. A graph of the modeled pressures for WDW-49 is included. The graph shows the yearly predicted modeled injection rates (250 gpm for each well). All predicted operational pressures correspond to a depth of 3440' below ground level and an original estimated formation pressure for the upper Miocene injection interval of 1555 psi.

The measured static formation pressures from the well tests, corrected to a depth of 3440' below ground level, show a formation pressure increase of 17 psi. This illustrates that injection operations at the plant have had limited impact on formation pressures and should continue to have limited impact on formation pressures in the future.

Static Formation Pressures From WDW-49 Well Test

Original Estimated Formation Pressure at 3440'	Static Formation Pressure at 3440'	Formation Pressure Increase, psi
1555	1572	+17

A comparison of the test permeability and transmissivity values with the modeled values of permeability and transmissivity for WDW-49 are given below:

Well Name	Test Permeability, md	Petition Permeability, md	Test Transmissivity, md-ft/cp	Petition Transmissivity, md-ft/cp
WDW-49 (Well 4)	1417	1350	169,620	313,700

4.0 MECHANICAL INTEGRITY TESTING

4.1 MAGNELOG CASING INSPECTION SURVEY

LOG DATA

Date Run:..Saturday, March 5, 1994
Logging Service Company: ....Atlas Wireline Services
Surface Casing Size and Depth Set:.............................10-3/4" 32.75# H-40 set at 1389'
Casing Size and Depth Set:...7-5/8" 26.4# K-55 set at 3306'
Top of logged interval: ....20'
Bottom logged interval: ....3302'
Copy of Log: ....Included as Appendix B
Interpretation By Atlas Wireline Services: ....In Appendix B

Two tracks are included on the Magnelog presentation: (1) Casing Collar locator (CCL) in the left track, and (2) Phase shift on the right track. The CCL and Phase shift logs are the primary interpretive curves reviewed in this evaluation. Phase shifts to the right indicate heavier weight or higher grade casing. Phase shifts to the left indicate lower weight or lower grade casing. The two pronged (double) kick to the right on the phase shift curve generally indicates casing collars (if confirmed by the CCL), centralizers, or other external cementing tools welded to the outside of the casing.

It is important to note that concentric strings of casing disrupt the induced magnetic field response displayed by the phase shift curve. The phase shift curve is generally shifted to the right due to the extra metal surrounding the casing being logged. The concentric casing phase shift on WDW-49 extends from the surface to 1390', or almost exactly where the 10-3/4" 32.75# H-40 is set at 1389'. Magnelog interpretation above 1390' is not really meaningful due to the interference of the surface casing.

The phase shift curve is initially calibrated inside the 7-5/8"" 26.4 lb casing with known internal diameter (ID) of 6.969". The repeat section from 3076' to 3326' (250') is assumed to be relatively consistent pipe with an average 6.969" ID. The average phase indicated on the Magnelog over the repeat section is about 137° (Roughly 3-2/5 divisions from the left).

There is apparently one external centralizer located at 3281' to 3285' (4' long). There are five relatively higher weight or grade joints from 1390' to 3302'. These higher weight or grade joints are located at 1785' to 1828' (43'), 1870' to 1913' (43'), two at 2420' to 2461' (41'), and 2461' to 2504'

(43'), and a fifth joint from 2590' to 2630' (40'). There were no joints that appeared to be of exceptionally lower weight or grade pipe. Aside from these minor points of low significance, there are no indications of any casing splits, parts, holes, or major corrosion points.

The CCL log shows 78 joints of casing from 30' to 3308'. The joints are of relatively consistent length, averaging 42.03 feet per joint. The low variation in average length is an indicator of higher quality casing in the well. Another indicator of potentially high quality seamless casing is the apparent angle of individual joint phase shifts over the length of the joints. This implies a slightly tapered OD throughout the length of the joint. Seamless casing has a tapered OD because of the manufacturing process of piercing a super heated solid steel bar with a rotating mandrel. The end the mandrel starts from will generally have a smaller ID than the far end where the point of the mandrel protrudes from the bar stock being forged into seamless pipe. This is because the unsupported far end of the mandrel is subject to slight vibration. In summary there is no indication of any casing integrity problems from any of the Magnelog traces.

4.2 ANNULUS PRESSURE TEST

Annulus pressure testing was conducted on Thursday, March 10, 1994. The annulus was pressured up to 1042 psig and monitored for ninety (90) minutes. No pressure loss was noted during the ninety minute period. Annulus Pressure Test data and plots are included in Appendix C.

4.3 RADIOACTIVE TRACER SURVEY

LOG DATA

Date Run:	March 11, 1994
Logging Service Company:	Western Atlas International
Tubing Size:	5 ½" 20 ppf N-80 carbon steel
Packer Depth:	3316' to 3322' (log measured depth)
Casing Size and Depth Set:	7 5/8" 26.4 lb./ft at 3306' and 3 joints Schedule 40 316 SS set at 3368'
Slotted Screen Liner size, length and depth:	4 ½" 316 Schedule 40 SS (0.020" screen) set from 3371.5' to 3579'
Plugged Back Total Depth (PBTD):	3433' Top of fill
Copy Of Log:	Included as Appendix D
Interpretation By Atlas Wireline Services:	In Appendix D

Major observations from the RAT log evaluation are as follows:

1. Passes #1, #2, #3, and #4 on both slug shots one and two have approximately the same area under their curves, and are simply spreading out due to repeated passes with the GR tool. The slug travels roughly the same distance between each of these four passes.
2. There appears to be downward fluid movement below 3433' because of the flattened shape of the RAT slug curve on both passes #5. This would indicate some of the injection interval below 3433' is accepting injection fluid.
3. The screen is at least partially plugged off to at least 3416', and possibly as deep as 3433', because passes #6 and #7 on both slug shots, turn around and travel back upwards. This indicates injection fluid is being dispersed across the open screened injection zone from 3433' up to at least 3410'.
4. The After Injection Background API GR Pass (File 25) compared to the Background API GR Log Before Injection indicates no is uphole fluid movement above the top of the completion interval at 3371.5'. The After Injection Background API GR Pass shows that all RA slug traces have completely disappeared.

There is no indication of behind pipe upward fluid movement above the top of the permitted interval at 3350'. Wellbore fill at 3433', and potential slotted screen plugging 3416', tend to confirm the high near wellbore damage indicated by the high skin effect of +69 calculated in the falloff testing portion of this report. The following Table 4.1 is a summarizes the RAT log testing program.

Table 4.1 - Radioactive Tracer Log Data Table

Run No.	Start Time	File No.	Depth From	Depth To	Inject Rate	Peak Depth	Comments	Slug Travel	Pass Travel
1	11:25:53	1	3,136	3,427	0		Background API GR log before injection		
2	11:52:38	2	3,000	3,433	0		Background GR No. 1 - Top of fill at 3,433'		
3	12:12:28	3	3,001	3,433	0		Background GR No. 2		
4		8	3,002	3,097	10	3,050	Pass 1 - Chase #1 released at 3,000'	50	50
5		9	3,028	3,198	10	3,128	Pass 2 - In 5-1/2" 20# tubing	128	78
6		10	3,102	3,298	10	3,232	Pass 3 - In tubing	232	104
7		11	3,202	3,397	10	3,330	Pass 4 - TIW packer @ 3,316'	330	98
8		12	3,290	3,438	10	3,433	Pass 5 - SS Screen set 3,371.5' to 3,579'	433	103
9		13	3,320	3,428	10	3,423	Pass 6 - Slug turned around and coming back up in permitted completion interval.	423	-10
10		14	3,000	3,428	10	3,411	Pass 7 - Possible plugged screen from 3,317.5' to 3,433'.	411	-12

11		15	2,997	3,147	10	3,060	Pass 1 - Chase #2 released at 3,000'	60	
12		16	3,044	3,197	10	3,135	Pass 2 - In 5-1/2" 20# tubing	135	75
13		17	3,109	3,298	10	3,219	Pass 3 - In tubing	219	84
14		18	3,190	3,399	10	3,317	Pass 4 - Slug at packer	317	98
15		19	3,280	3,427	10	3,415	Pass 5 - Still moving down inside SS screen	415	98
16		20	3,361	3,428	10	3,416	Pass 6 - Still moving down inside SS screen	416	1
17		21	3,340	3,427	10	3,410	Pass 7 - Slug turned around and coming back up in permitted completion interval.	410	-6
18	13:51:33	22	3,348		120		Stationary reading #1 - When injection rate changed from 10 to 120 gpm, the ejector leaked RA slug which was detected by the bottom detector.		
19	14:07:10	23	3,348		120		Stationary reading #2		
20	14:23:02	24	3,358		120		Stationary reading #3		
21	14:41:21	25	2,906	3,427	0		After injection background GR pass		

APPENDIX A - TUBING TALLY

WDW-49 Tubing Tally (March 4, 1994)						
5 1/2" N-80 20# LTC Injection Tubing Strap						
Joint No.	Length	Joint No.	Length	Joint No.	Length	
1	42.57	11	42.51	21	42.53	
2	42.54	12	42.55	22	42.57	
3	42.62	13	42.45	23	42.55	
4	42.95	14	42.53	24	42.00	
5	42.42	15	42.70	25	42.45	
6	42.50	16	42.55	26	42.58	
7	38.12	17	42.48	27	42.50	
8	42.42	18	42.47	28	42.48	
9	42.54	19	42.55	29	40.50	
10	42.55	20	42.52	30	37.95	
Totals	421.23		425.31		418.11	1,264.65
31	42.50	41	42.60	51	38.61	
32	42.40	42	42.50	52	42.48	
33	39.65	43	42.43	53	42.40	
34	42.40	44	42.50	54	42.48	
35	42.45	45	42.35	55	42.45	
36	42.50	46	42.35	56	42.60	
37	42.45	47	42.40	57	42.61	
38	42.55	48	42.40	58	42.60	
39	42.35	49	42.40	59	42.50	
40	42.45	50	42.55	60	42.55	
Totals	421.70		424.48		421.28	1,267.46
61	42.40	71	42.38	80	36.9	
62	39.00	72	40.70	81	42.54	
63	42.44	73	42.51	82	41.8	
64	39.00	74	42.55	83	42.58	
65	42.48	75	42.32			
66	42.48	76	42.48			
67	42.58	77	42.62			
68	42.50	78	42.58			
69	42.40	79	38.70			
70	42.61					
Totals	417.89		376.84		163.82	958.55
Totals	839.12		847.01		839.39	3,490.66
Column	Length	Set Depth		Average Joint Length:		42.11
1 to 10	421.23	421.23				
11 to 20	425.31	846.54		Extra Joints		
21 to 30	418.11	1,264.65		80 to 83	163.82	
31 to 40	421.70	1,686.35				
41 to 50	424.48	2,110.83				
51 to 60	421.28	2,532.11				
61 to 70	417.89	2,950.00				
71 to 79	376.84	3,326.84				

TBGTALLY.XLS

J.A.M SERVICES REPORT

COLOR	RED	WHITE	BLUE
SIZE	5 1/2		
THREAD	LTC		
WEIGHT	20#		
GRADE	N-80		
MAX TQ	5350		
OPT TQ	4280		
MIN TQ	3210		
REF TQ	450		
MAX TNS	5		
MIN TNS	0		
MAX SHLDR	0		
MIN SHLDR	0		
JTS RAN	79		
FOOTAGE	3350		
BACK OUTS	0		
REJECTS	0		

J.A.M SERVICES REPORT

Company :	ECO SOLUTIONS
Service Ticket Number:	721483
Diskette I.D. Number:	LAF-361
Lease :	HORCHOT CELANESE
Well Number :	4
Rig Name :	WELL TECH #14
Tong Model :	W/FORD 7.625 W/UKBU
Field / Block :	CELANESE PLANT
Customer Representative :	MR. BOB HALL
Pipe Condition :	NEW
Thread Lubricant :	API-MODIFIED
Computer #1 :	LV-2, 093
Computer #2 :	LV-2, 098
Technician #1 :	TONY UDOVICH
Technician #2 :	BRIAN VIDRINE
Torque information supplied by :	WEATHERFORD JAM DEPT.

J.A.M SERVICES REPORT

Time Summary :

The following is a summary of the time spent on this job.

Departed Weatherford service point @ 17:00 (03-06-94) .

Arrived at the location / rig @ 23:59 (03-06-94) .

Started running pipe @ 14:30 (03-07-94) .

Finished running pipe @ 09:30 (03-08-94) .

Departed the location / rig @ 11:00 (03-08-94) .

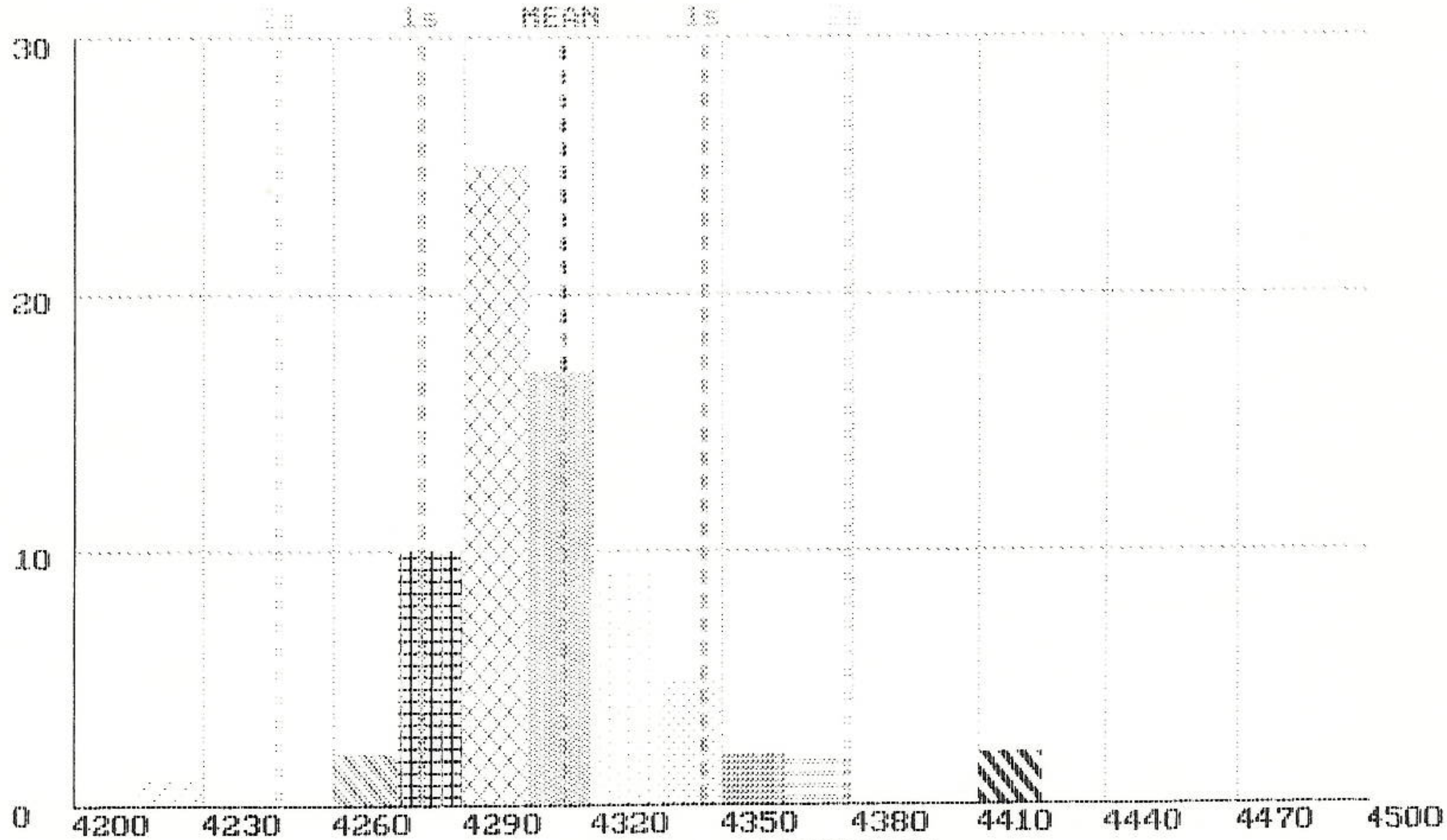
Returned to the Weatherford service point @ 18:00 (03-08-94).

Remarks :

Job went well, there was no downtime due to Weatherford equipment.

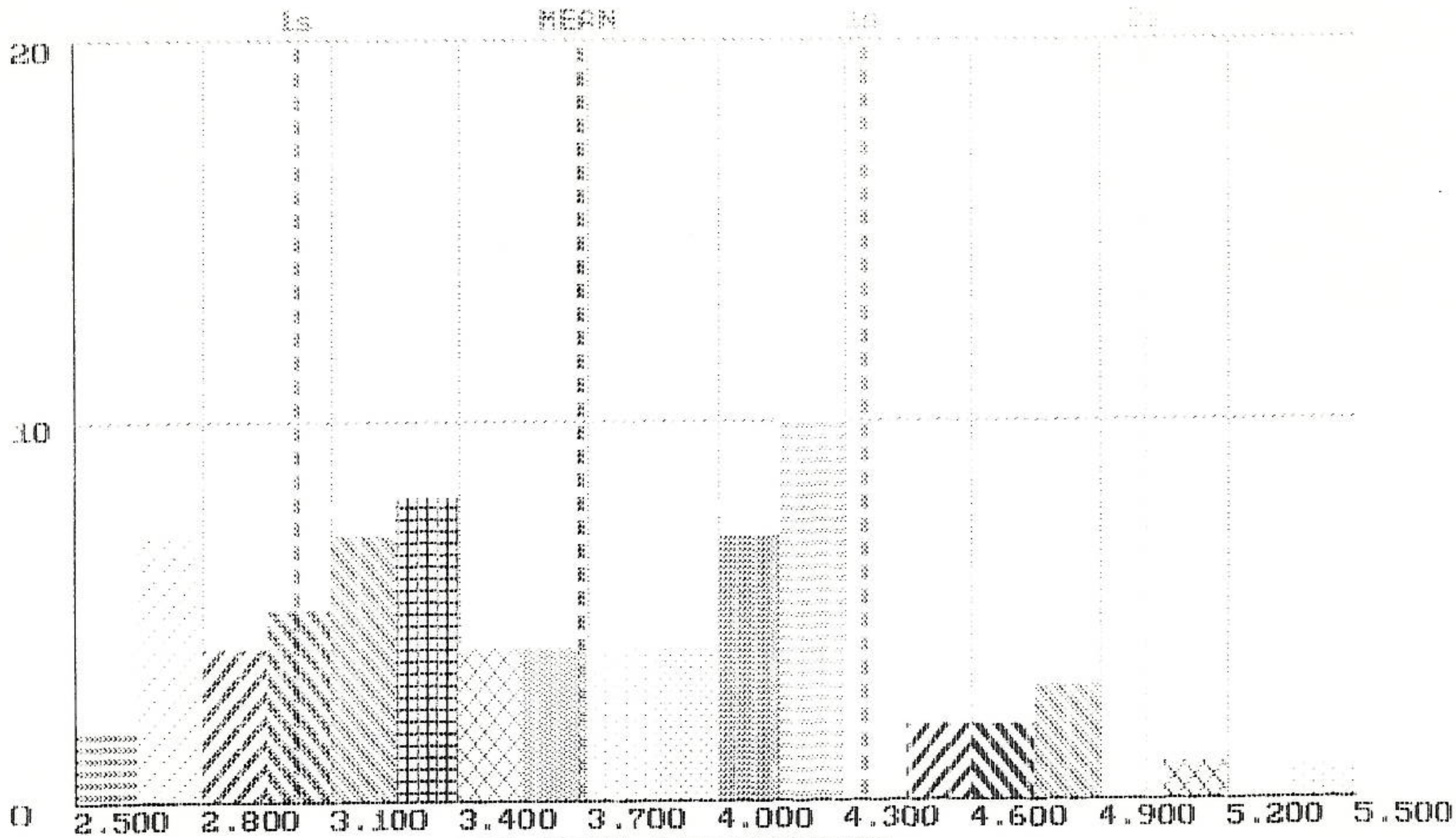
All connections were doped on the floor with API-Modified dope. This string of pipe made up with a consistent thread engagement recorded, using API torques and running procedures.

Weatherford experienced no accidents of any kind on this job. If you have any questions regarding this job or any other job, please do not hesitate to call us. Thank you very much for the work.



PEAK TORQUE DISTRIBUTION

LTC 3 1/2 20# N-80
MEAN = 4313 STANDARD DEVIATION = 33.307
TOTAL CONNECTIONS = 79 IN RANGE = 79

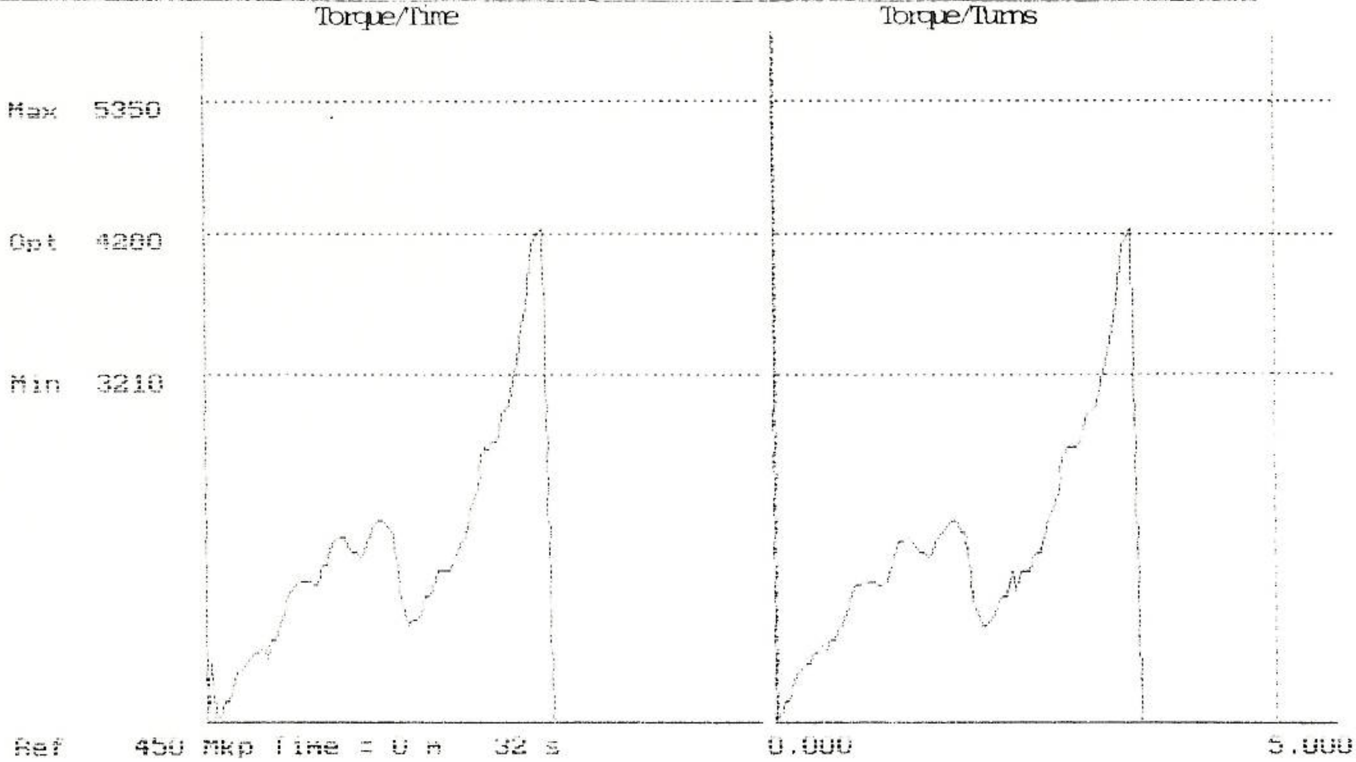


TOP TURNS DISTRIBUTION

LTC 3 1/2 20# N-80
MEAN = 3.684 STANDARD DEVIATION = 0.667
TOTAL CONNECTIONS = 79 IN RANGE = 79

WEATHERFORD JAM SERVICES

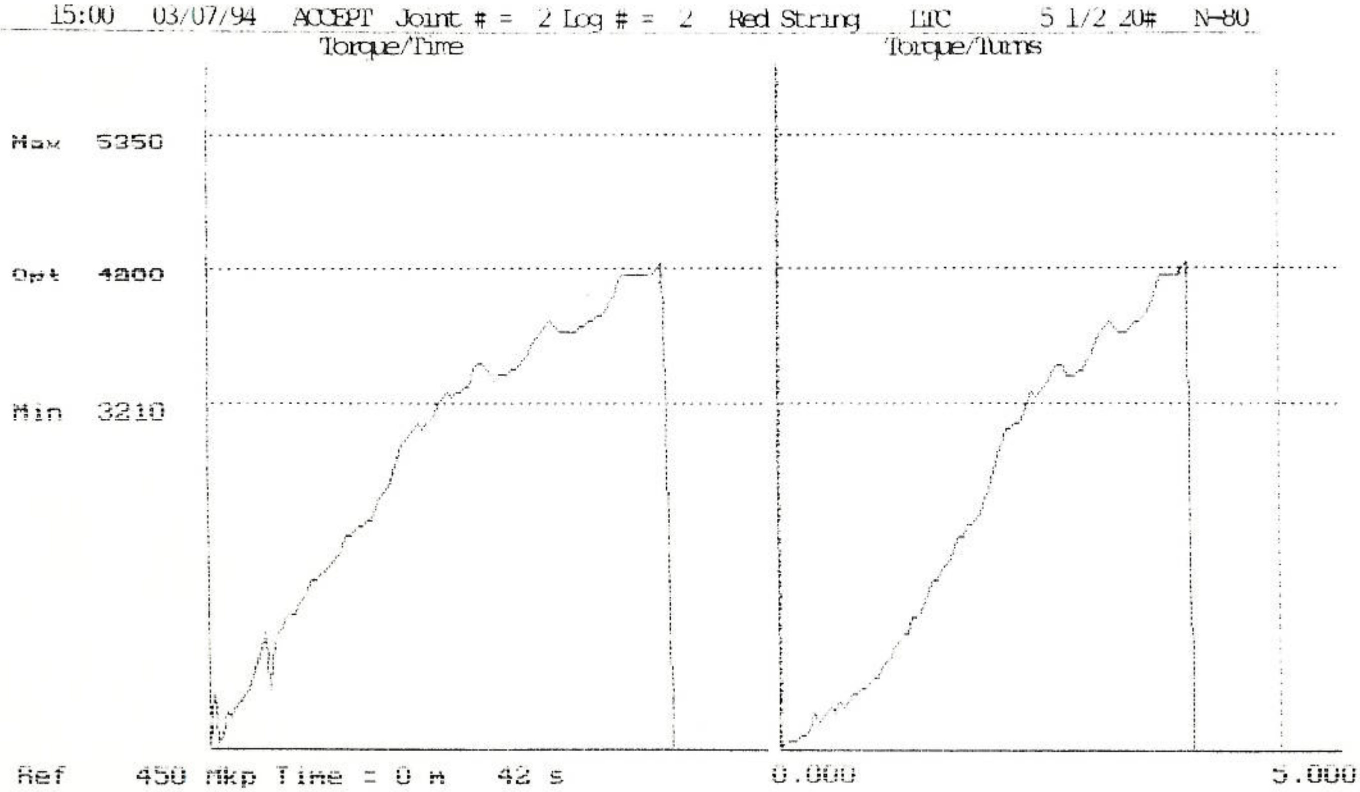
14:46 03/07/94 ACCEPT Joint # = 1 Log # = 1 Red String LTC 5 1/2 20# N-80



Applied Torque = 4325 Top Turns = 3.575

Comments:OK BV, JOINT TO SEALS...

15:00 03/07/94 ACCEPT Joint # = 2 Log # = 2 Red String LTC 5 1/2 20# N-80

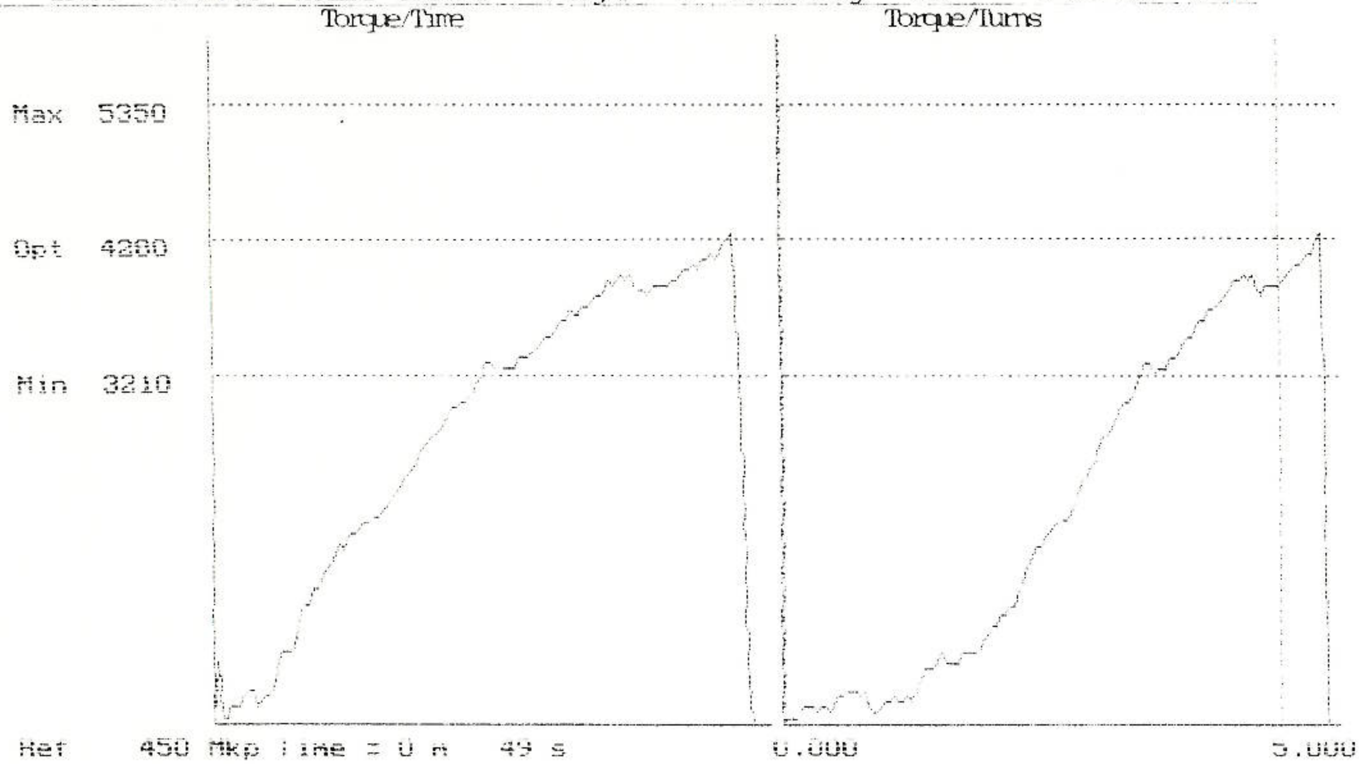


Applied Torque = 4298 Top Turns = 4.077

Comments:OK BV

WEATHERFORD JAM SERVICES

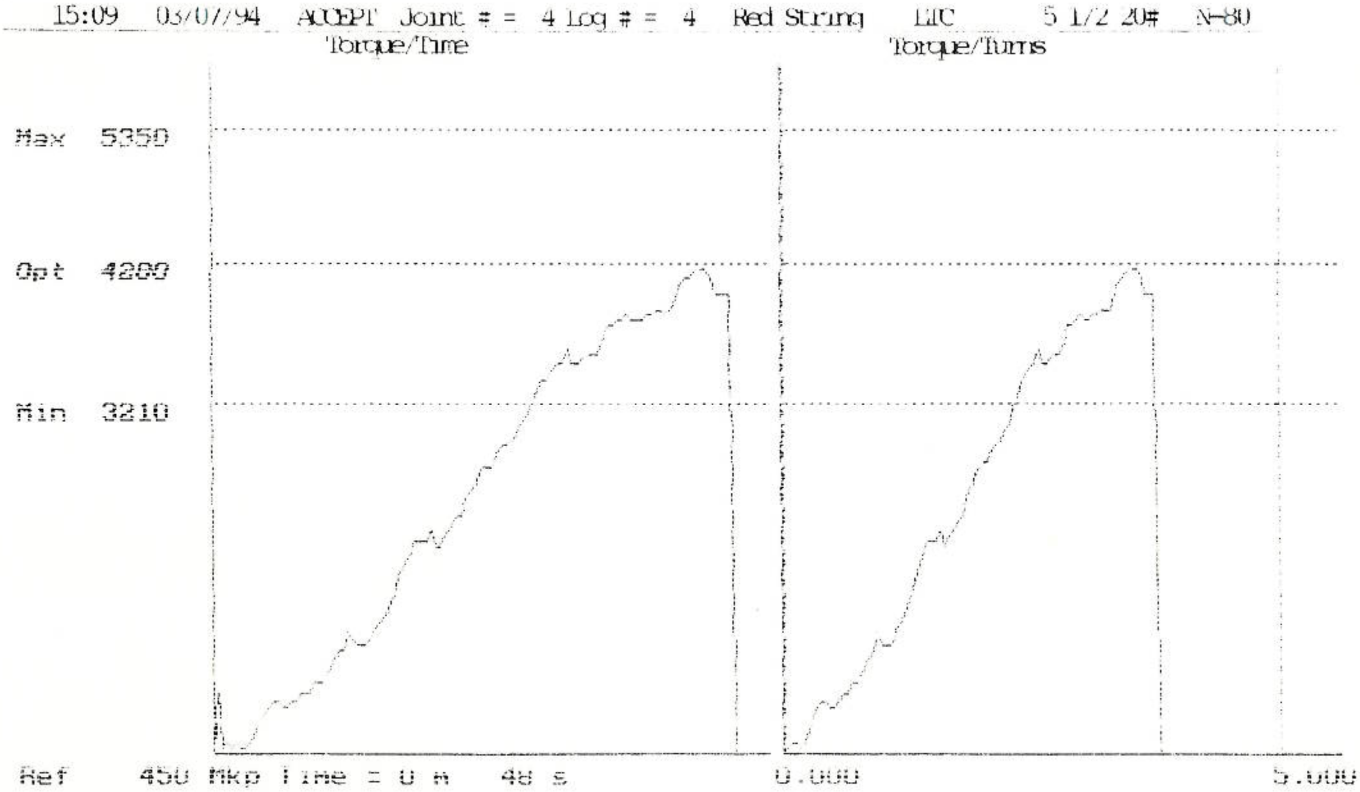
15:04 03/07/94 ACCEPT Joint # = 3 Log # = 3 Red String LTC 5 1/2 20# N-80



Applied Torque = 4298 Top Turns = 5.415

Comments:OK TU

15:09 03/07/94 ACCEPT Joint # = 4 Log # = 4 Red String LTC 5 1/2 20# N-80

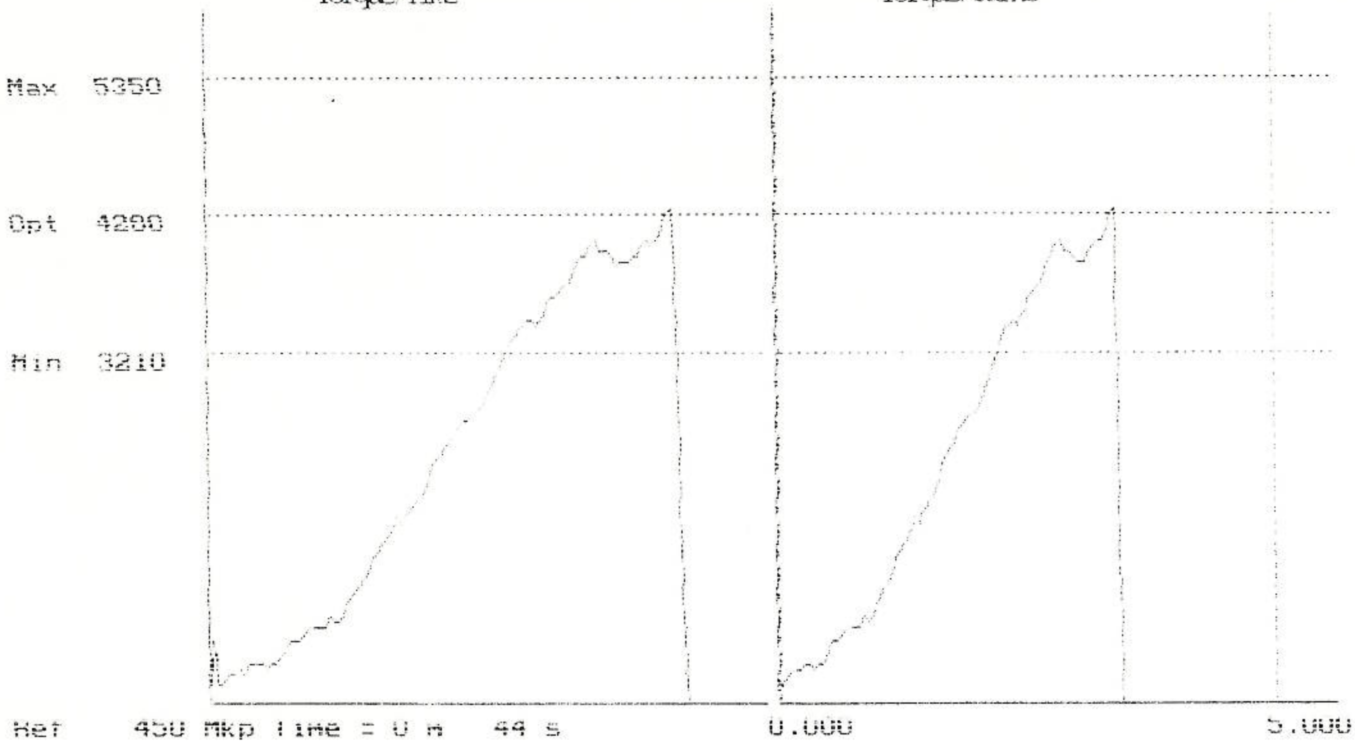


Applied Torque = 4218 Top Turns = 3.721

Comments:OK TU

WEATHERFORD JAM SERVICES

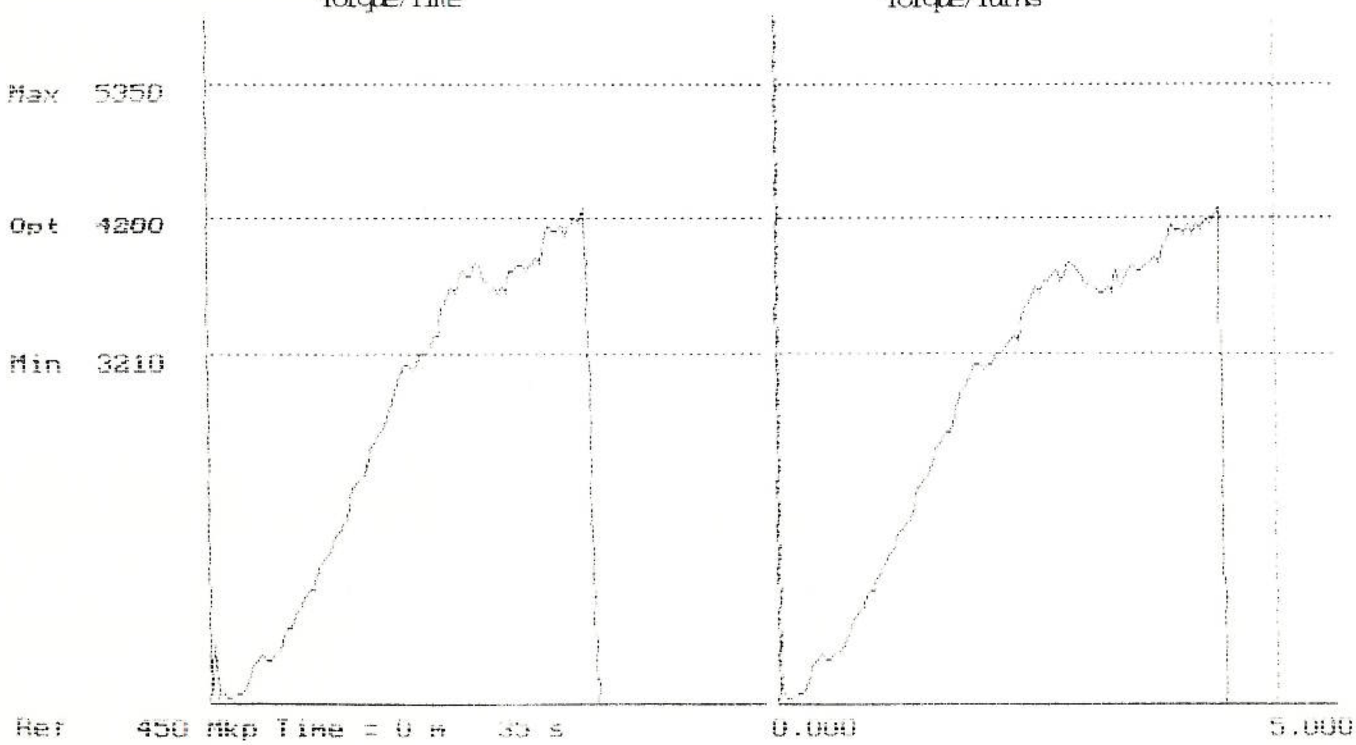
15:15 03/07/94 ACCEPT Joint # = 5 Log # = 5 Red String LTC 5 1/2 20# N-80



Applied Torque = 4312 Top Turns = 3.365

Comments:Ok TU

15:19 03/07/94 ACCEPT Joint # = 6 Log # = 6 Red String LTC 5 1/2 20# N-80

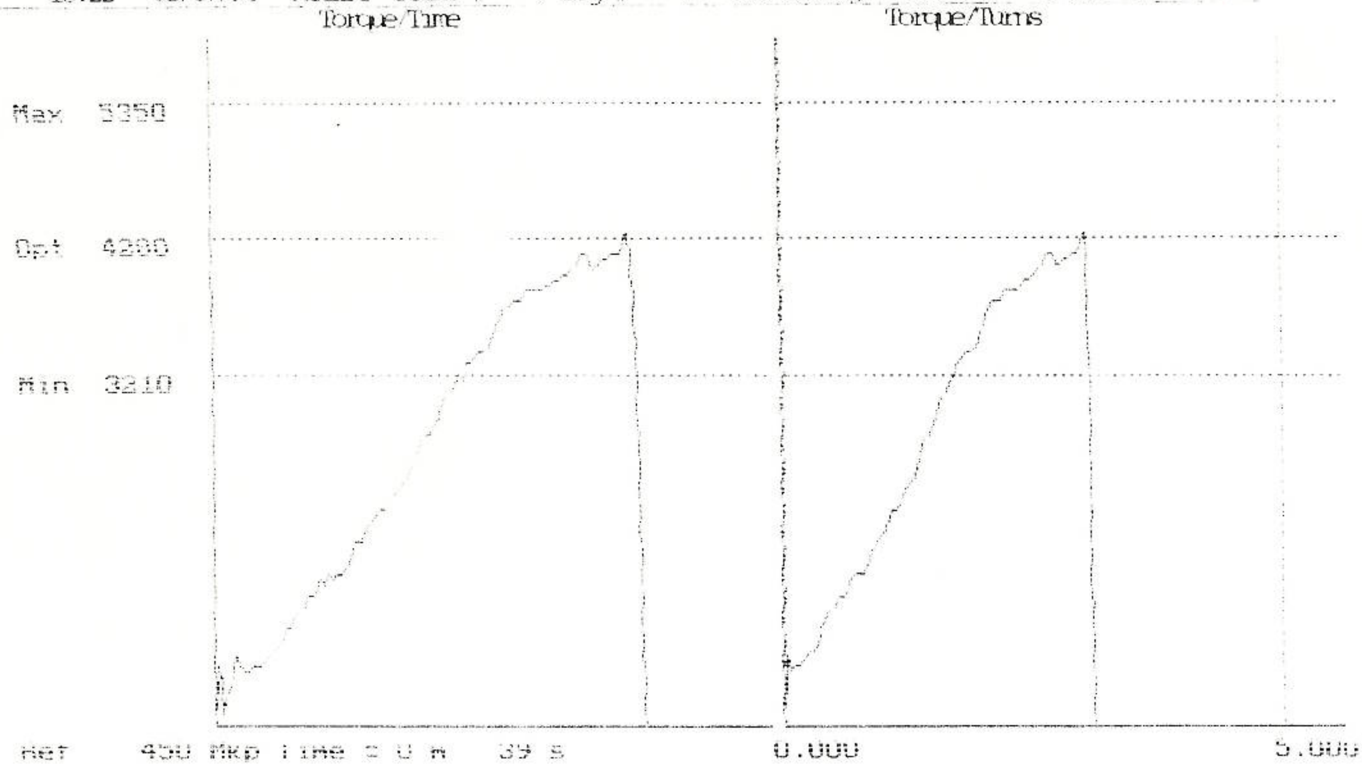


Applied Torque = 4345 Top Turns = 4.411

Comments:OK TU

WEATHERFORD JAM SERVICES

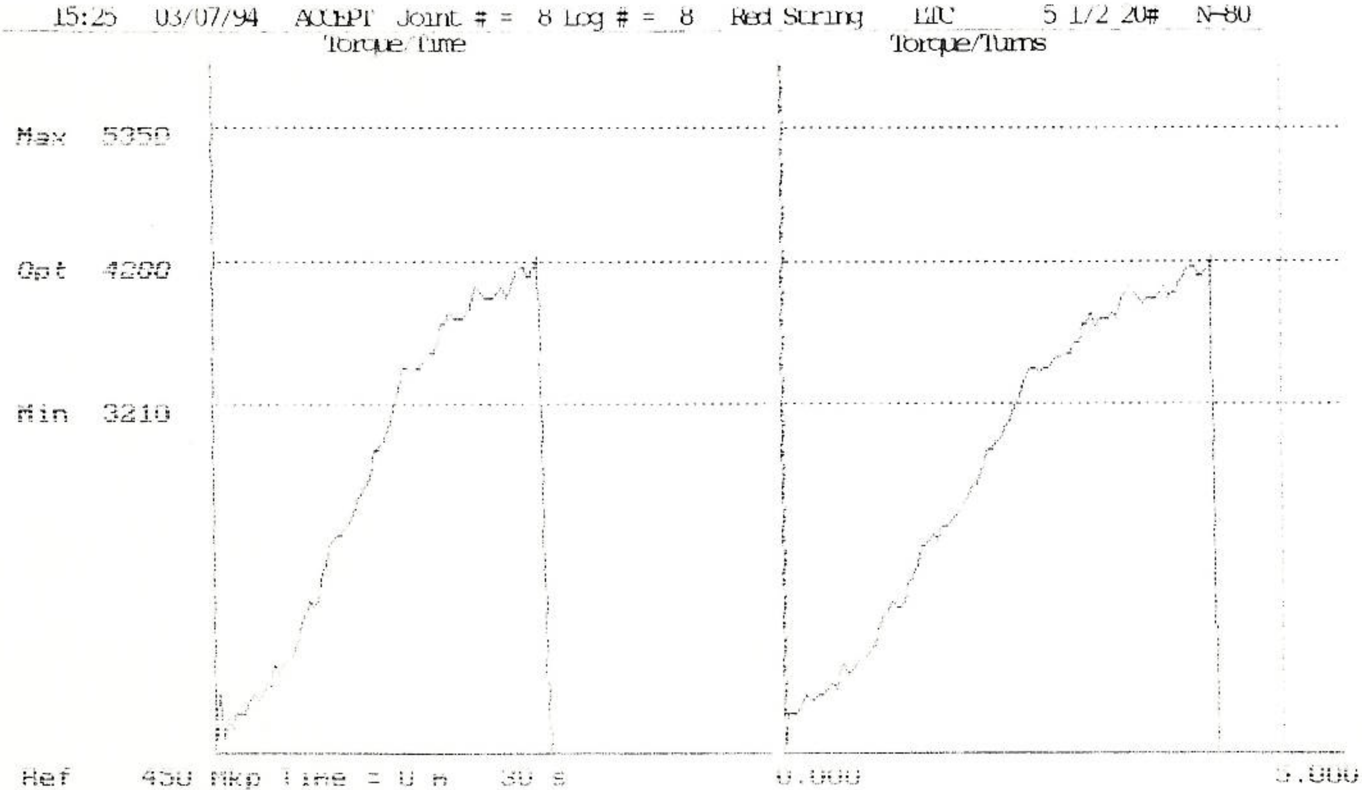
15:22 03/07/94 ACCEPT Joint # = 7 Log # = 7 Red String LTC 5 1/2 20# N-80



Applied Torque = 4312 Top Turns = 3.043

Comments:OK TU

15:25 03/07/94 ACCEPT Joint # = 8 Log # = 8 Red String LTC 5 1/2 20# N-80

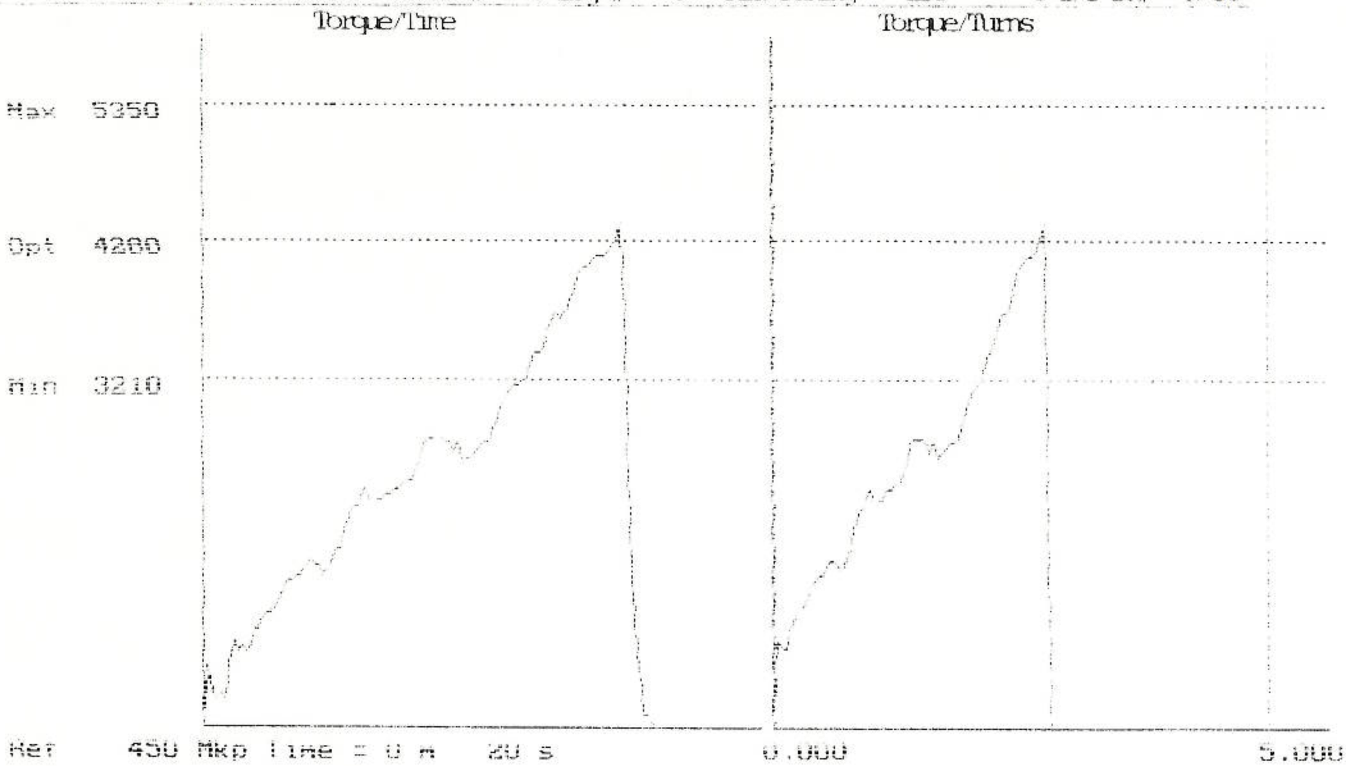


Applied Torque = 4312 Top Turns = 4.293

Comments:OK TU

WEATHERFORD JAM SERVICES

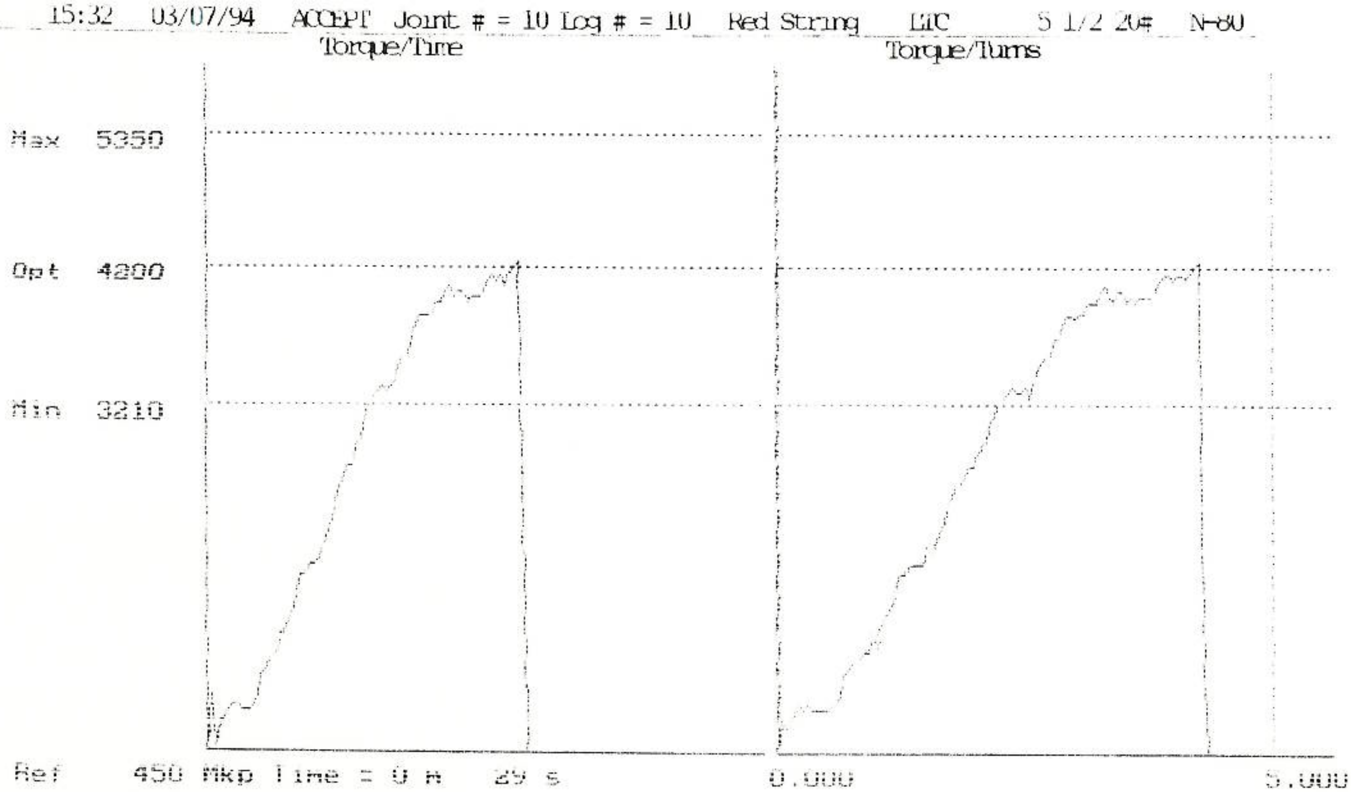
15:29 03/07/94 ACCEPT Joint # = 9 Log # = 9 Red String LTC 5 1/2 20# N-80



Applied Torque = 4385 Top Turns = 2.749

Comments:OK TU

15:32 03/07/94 ACCEPT Joint # = 10 Log # = 10 Red String LTC 5 1/2 20# N-80

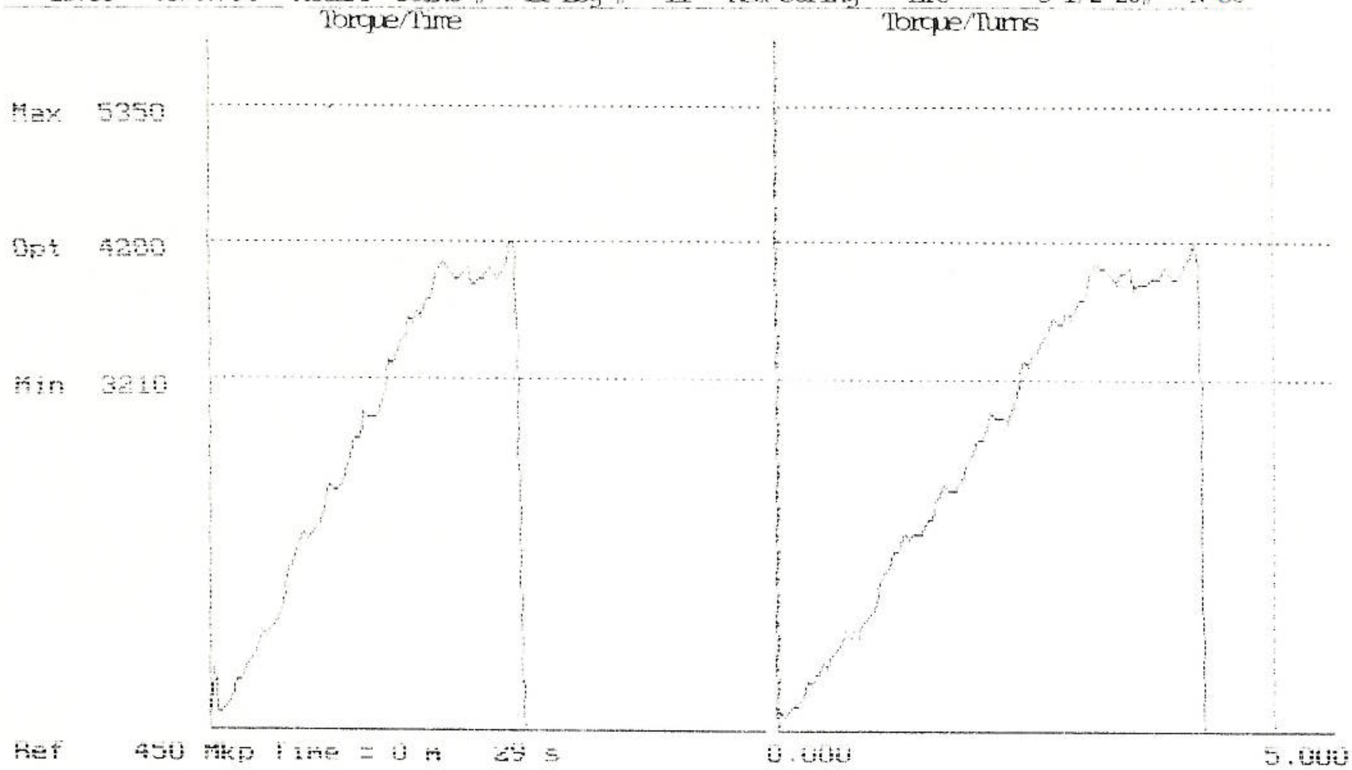


Applied Torque = 4305 Top Turns = 4.256

Comments:OK TU

WEATHERFORD JAM SERVICES

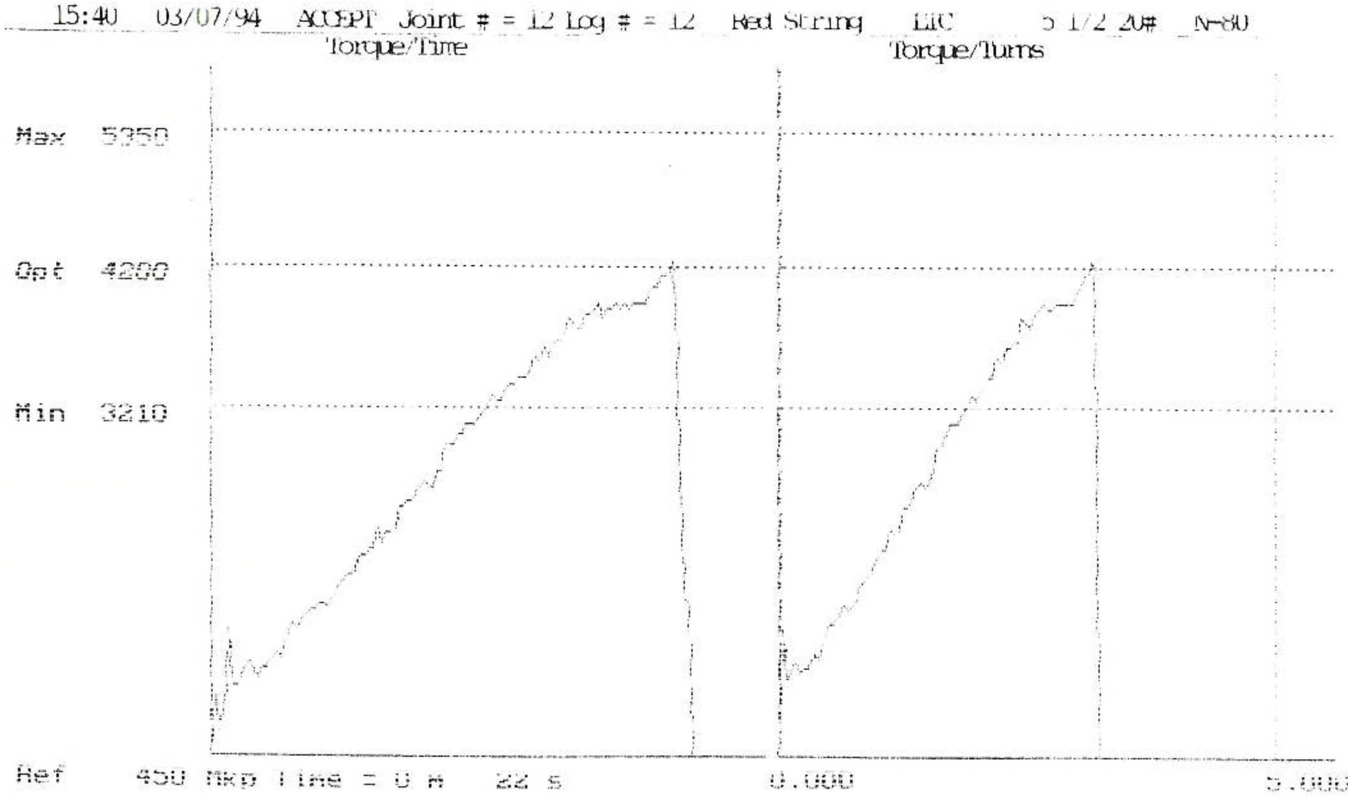
15:36 03/07/94 ACCEPT Joint # = 11 Log # = 11 Red String LTC 5 1/2 20# N-80



Applied Torque = 4292 Top Turns = 4.225

Comments:OK TU

15:40 03/07/94 ACCEPT Joint # = 12 Log # = 12 Red String LTC 5 1/2 20# N-80

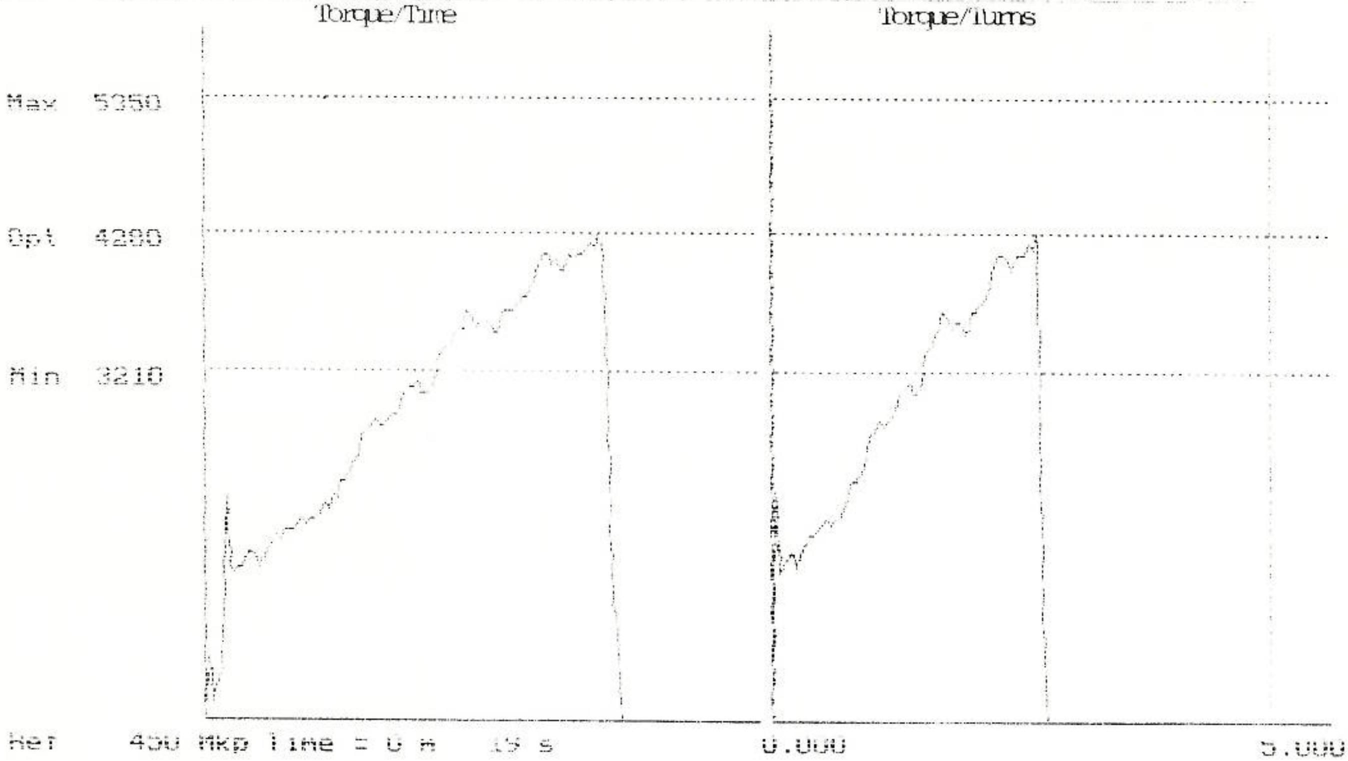


Applied Torque = 4305 Top Turns = 3.155

Comments:OK TU

WEATHERFORD JAM SERVICES

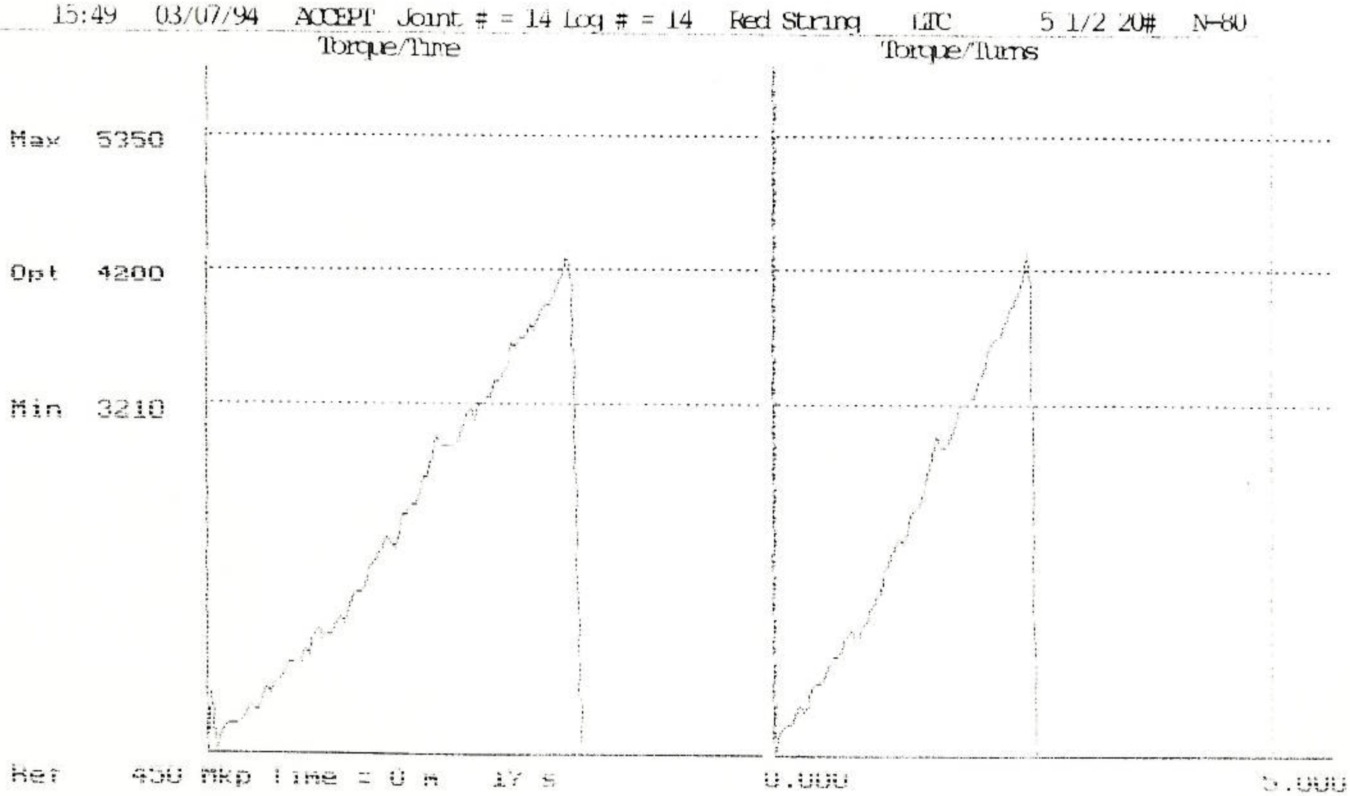
15:46 03/07/94 ACCEPT Joint # = 13 Log # = 13 Red String LTC 5 1/2 20# N-80



Applied Torque = 4292 Top Turns = 2.668

Comments:OK BV, LATE SHIFT

15:49 03/07/94 ACCEPT Joint # = 14 Log # = 14 Red String LTC 5 1/2 20# N-80

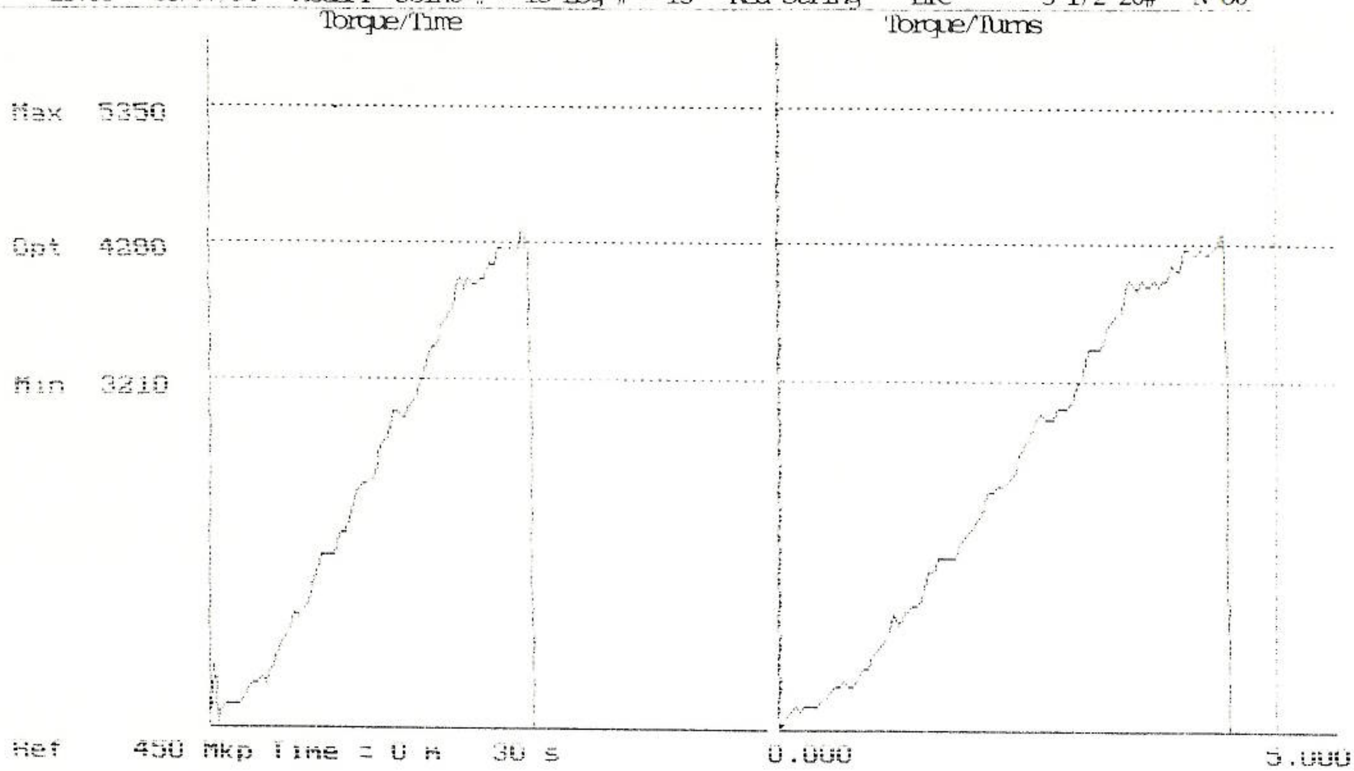


Applied Torque = 4412 Top Turns = 2.542

Comments:OK BV

WEATHERFORD JAM SERVICES

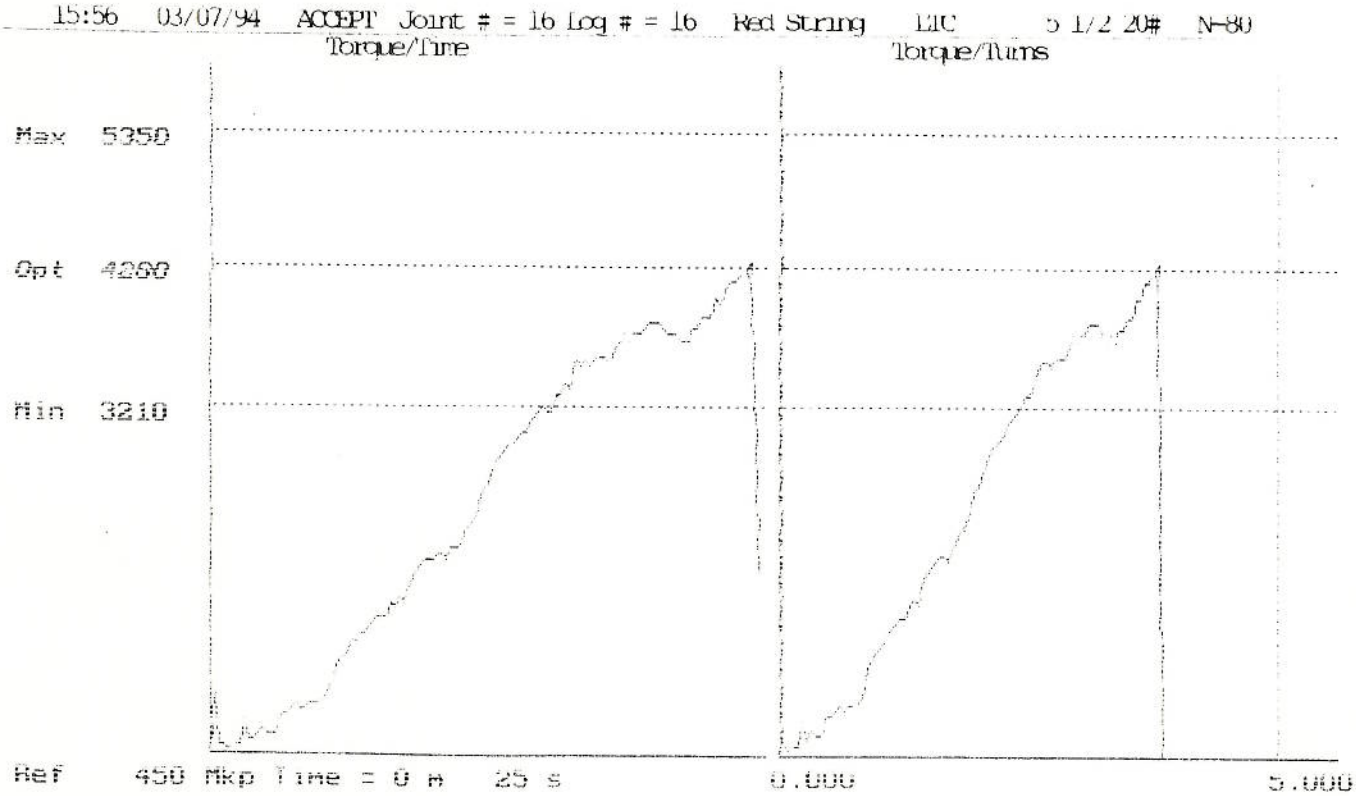
15:53 03/07/94 ACCEPT Joint # = 15 Log # = 15 Red String LTC 5 1/2 20# N-80



Applied Torque = 4385 Top Turns = 4.449

Comments:OK BV

15:56 03/07/94 ACCEPT Joint # = 16 Log # = 16 Red String LTC 5 1/2 20# N-80

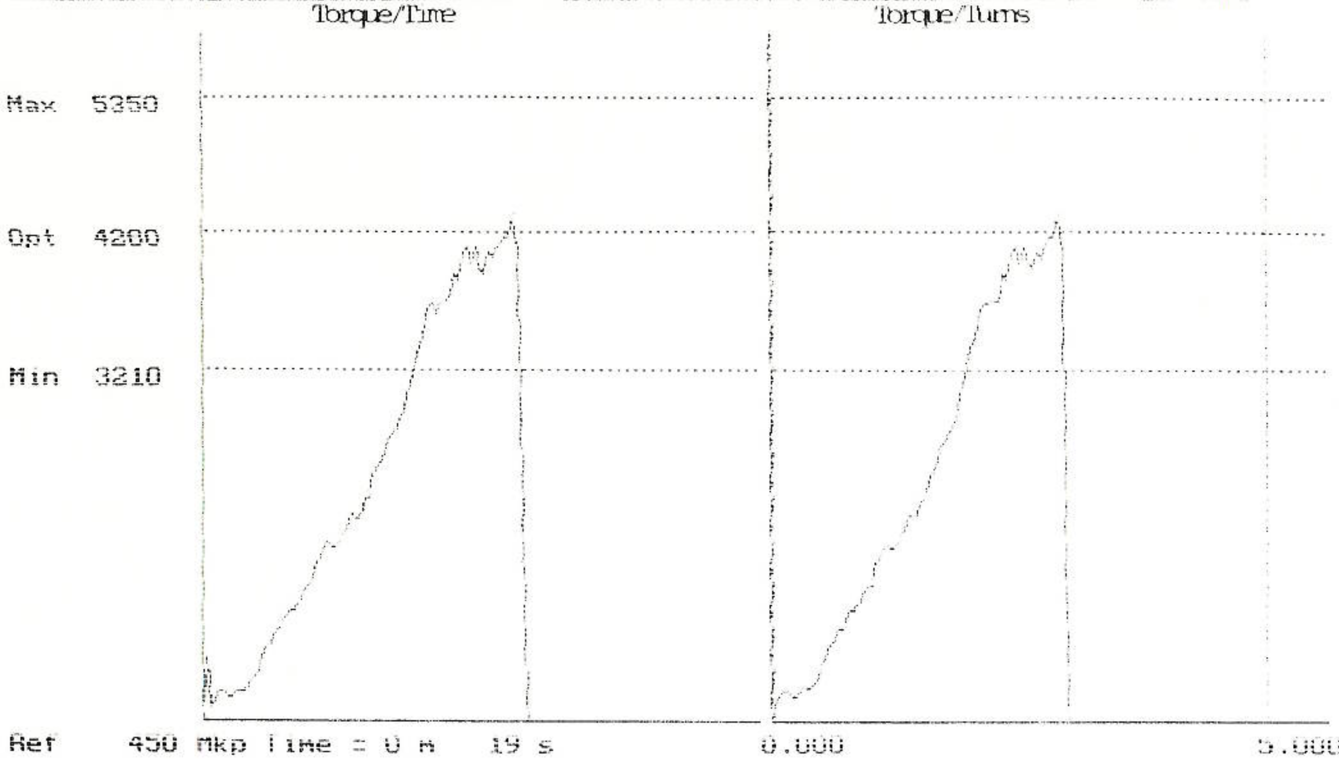


Applied Torque = 4298 Top Turns = 3.769

Comments:OK BV

WEATHERFORD JAM SERVICES

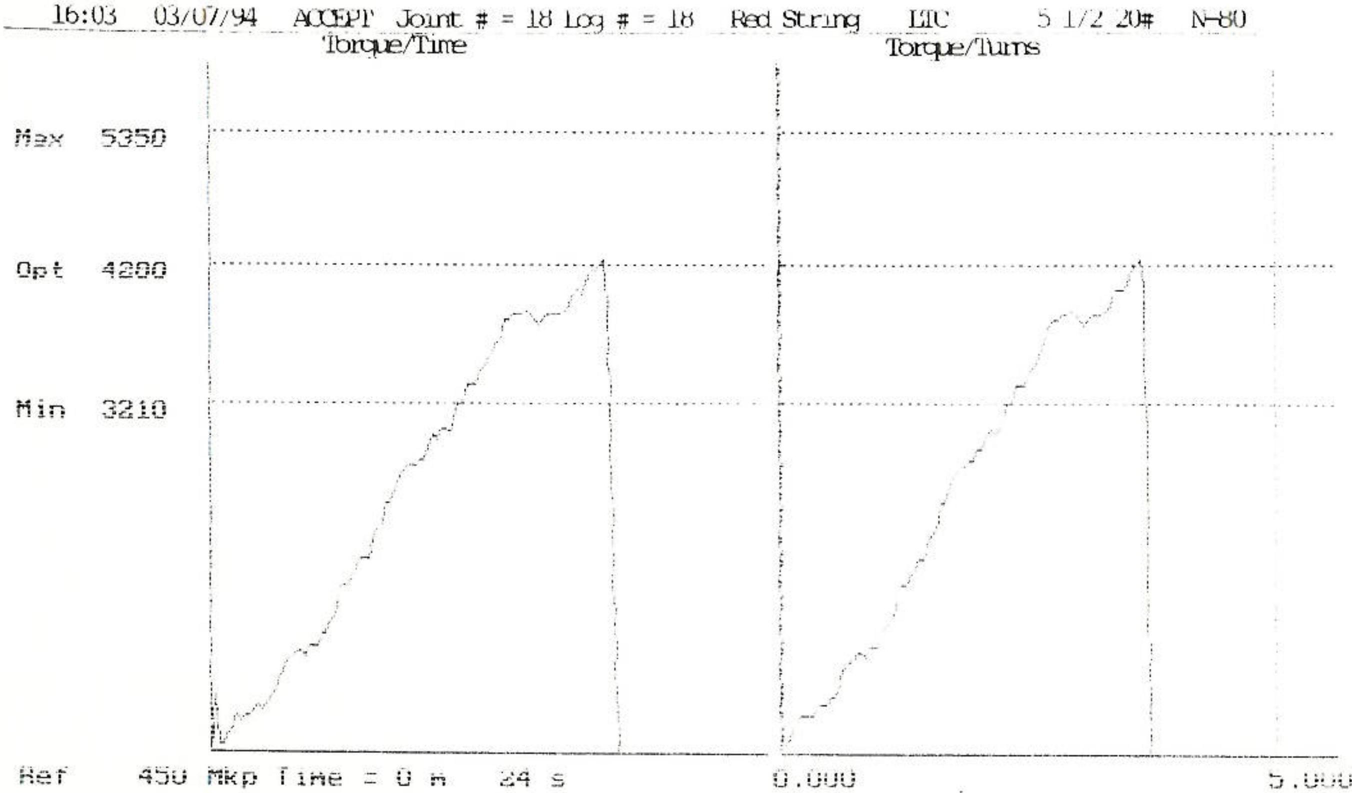
15:59 03/07/94 ACCEPT Joint # = 17 Log # = 17 Red String LTC 5 1/2 20# N-80



Applied Torque = 4378 Top Turns = 2.932

Comments:OK BV

16:03 03/07/94 ACCEPT Joint # = 18 Log # = 18 Red String LTC 5 1/2 20# N-80

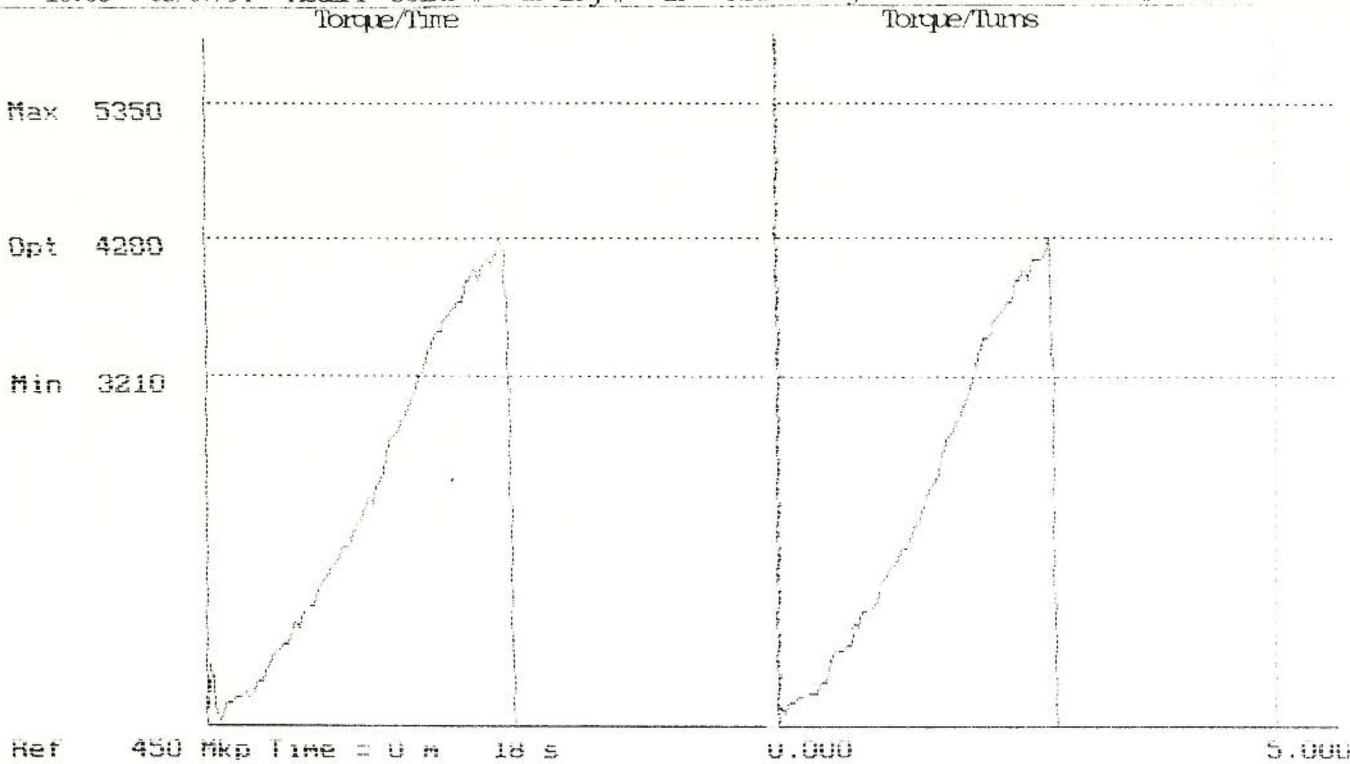


Applied Torque = 4298 Top Turns = 3.664

Comments:OK BV

WEATHERFORD JAM SERVICES

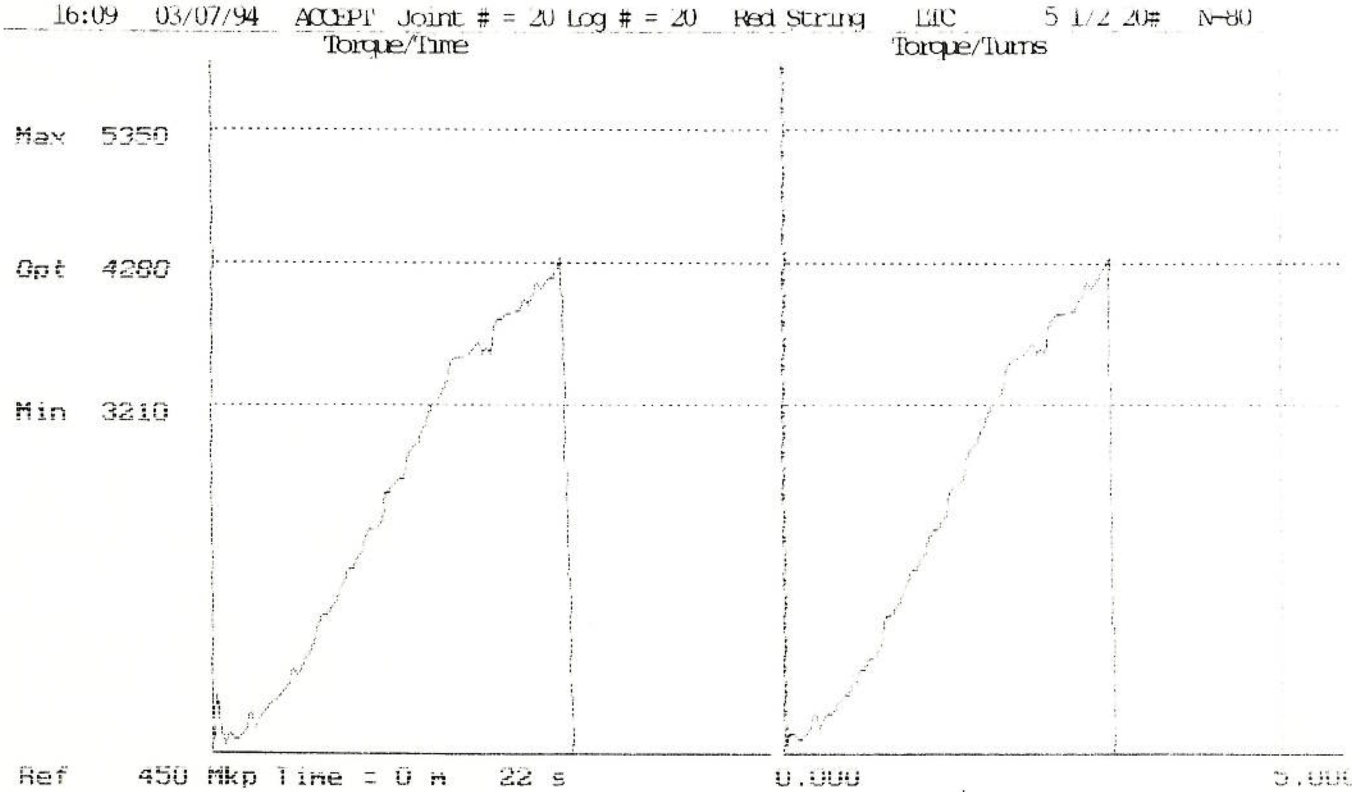
16:06 03/07/94 ACCEPT Joint # = 19 Log # = 19 Red String LTC 5 1/2 20# N-80



Applied Torque = 4292 Top Turns = 2.743

Comments:OK BV

16:09 03/07/94 ACCEPT Joint # = 20 Log # = 20 Red String LTC 5 1/2 20# N-80

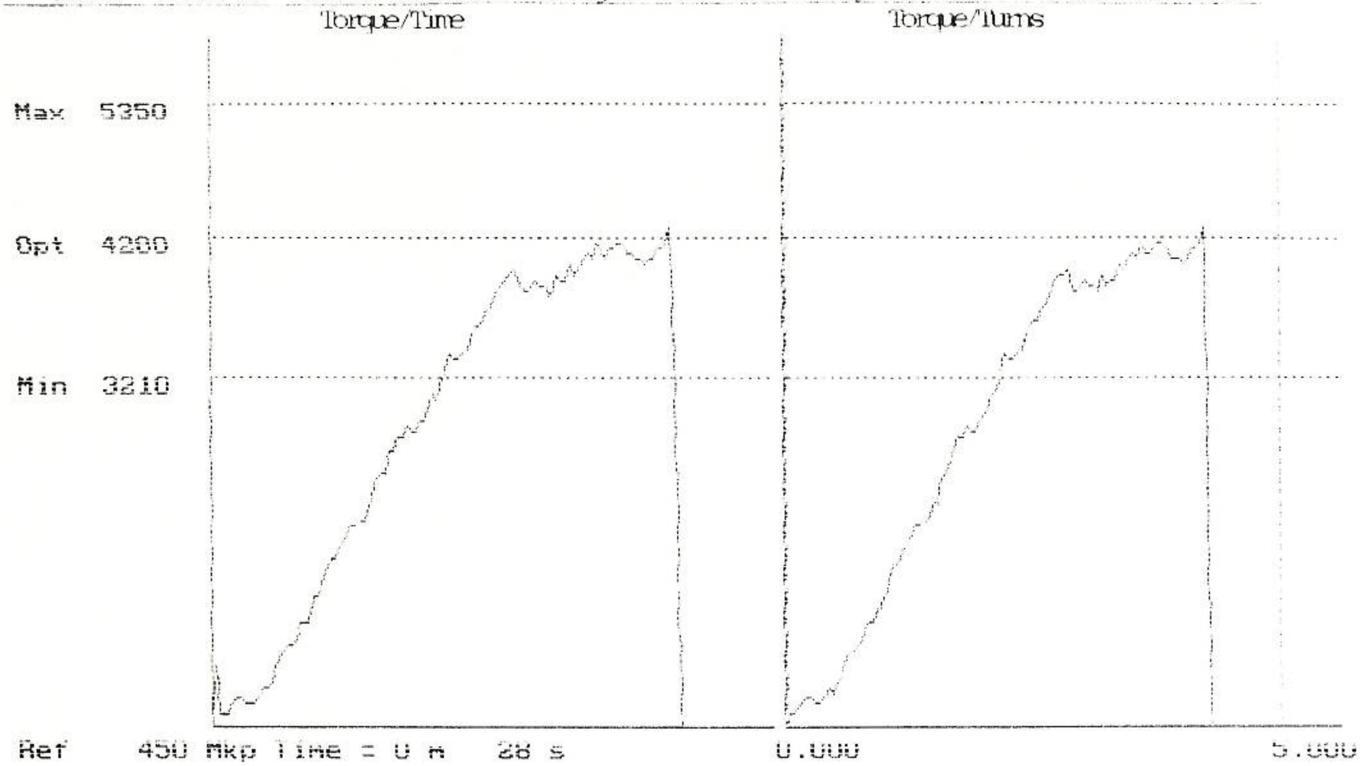


Applied Torque = 4318 Top Turns = 3.255

Comments:OK BV

WEATHERFORD JAM SERVICES

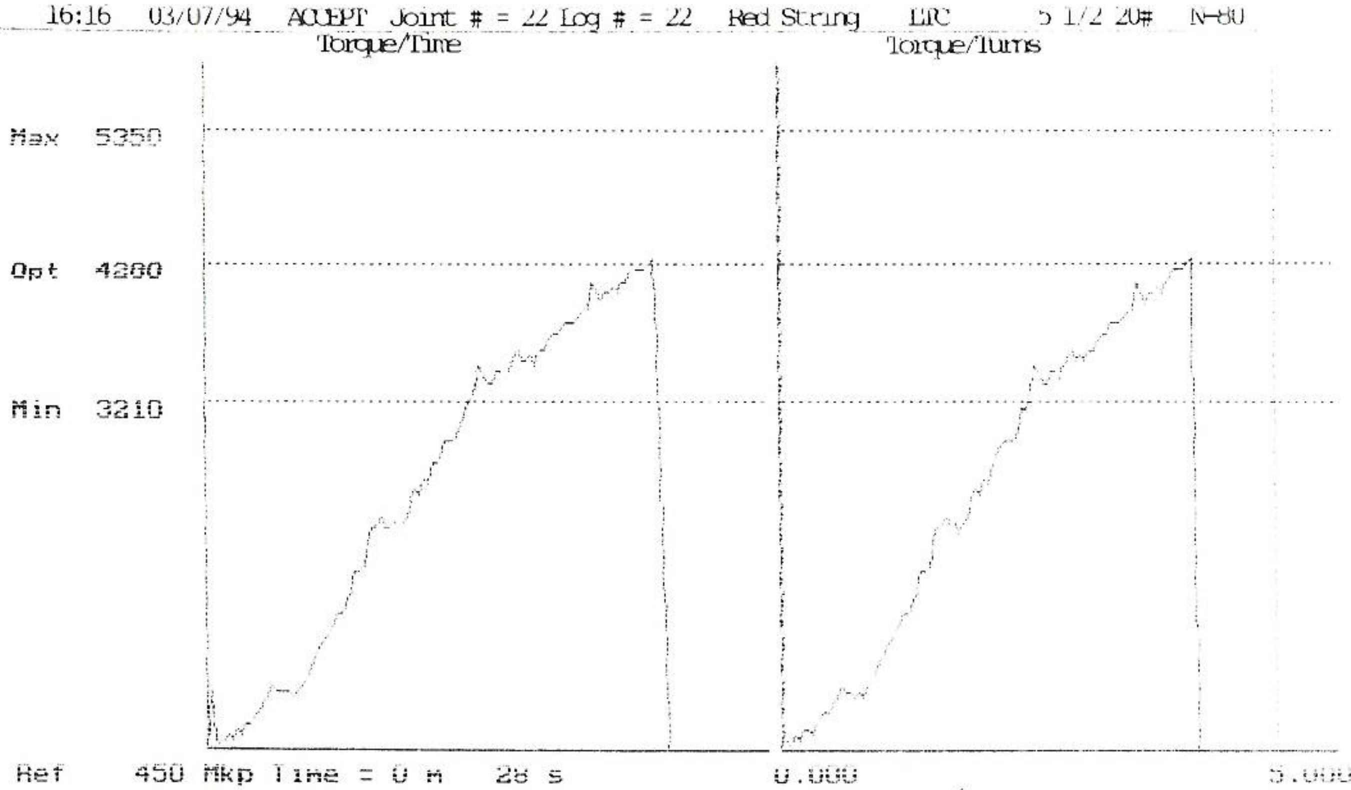
16:12 03/07/94 ACCEPT Joint # = 21 Log # = 21 Red String LTC 5 1/2 20# N-80



Applied Torque = 4345 Top Turns = 4.234

Comments:OK BV

16:16 03/07/94 ACCEPT Joint # = 22 Log # = 22 Red String LTC 5 1/2 20# N-80



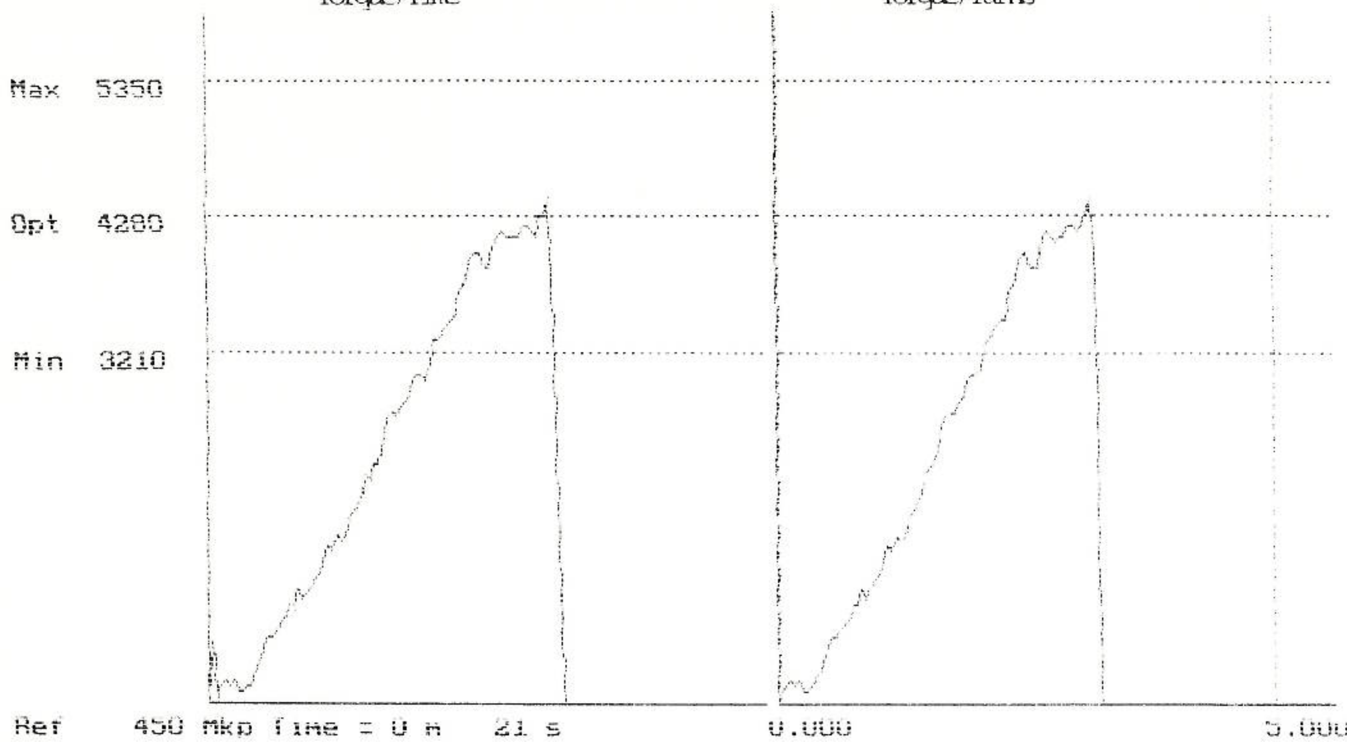
Applied Torque = 4298 Top Turns = 4.157

Comments:OK TU

WEATHERFORD JAM SERVICES

16:20 03/07/94 ACCEPT Joint # = 23 Log # = 23 Red String LTC 5 1/2 20# N-80

Torque/Time Torque/Turns

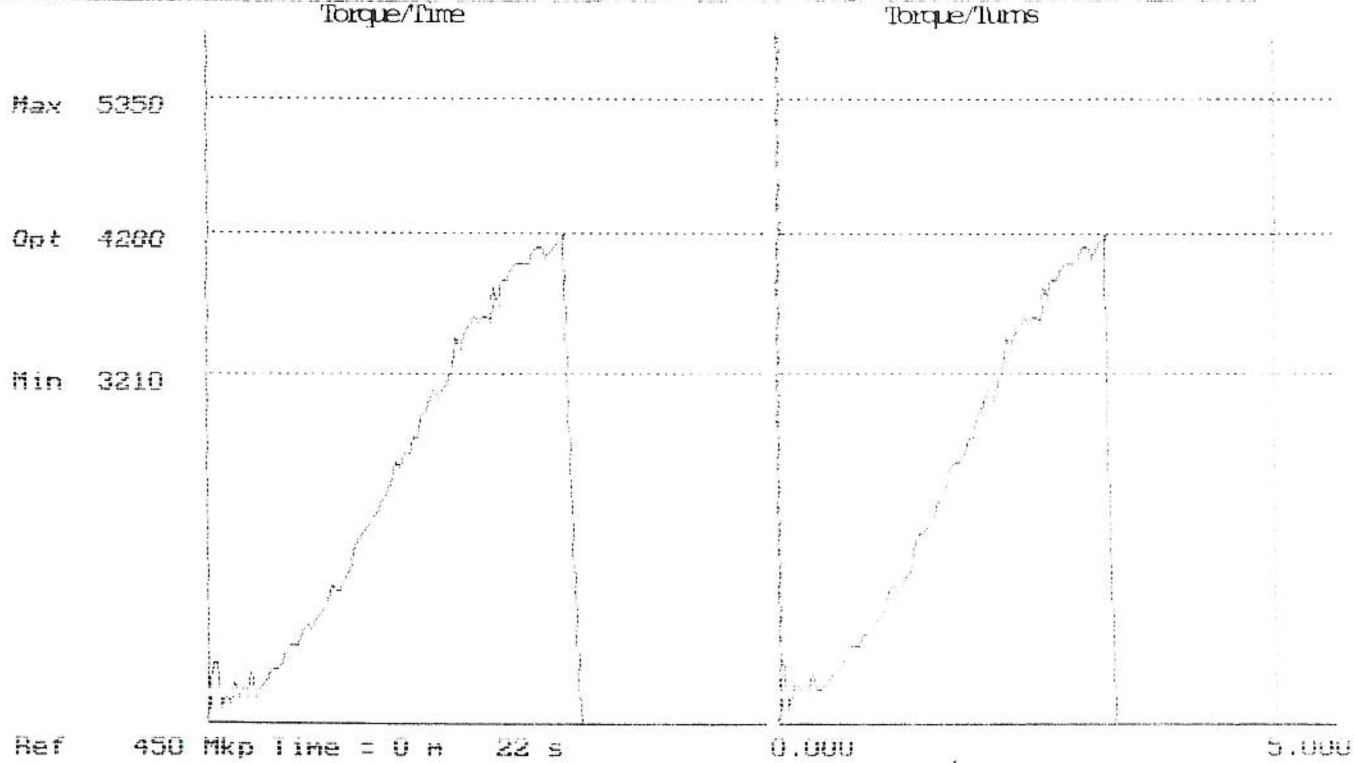


Applied Torque = 4412 Top Turns = 3.187

Comments:OK TU

16:23 03/07/94 ACCEPT Joint # = 24 Log # = 24 Red String LTC 5 1/2 20# N-80

Torque/Time Torque/Turns

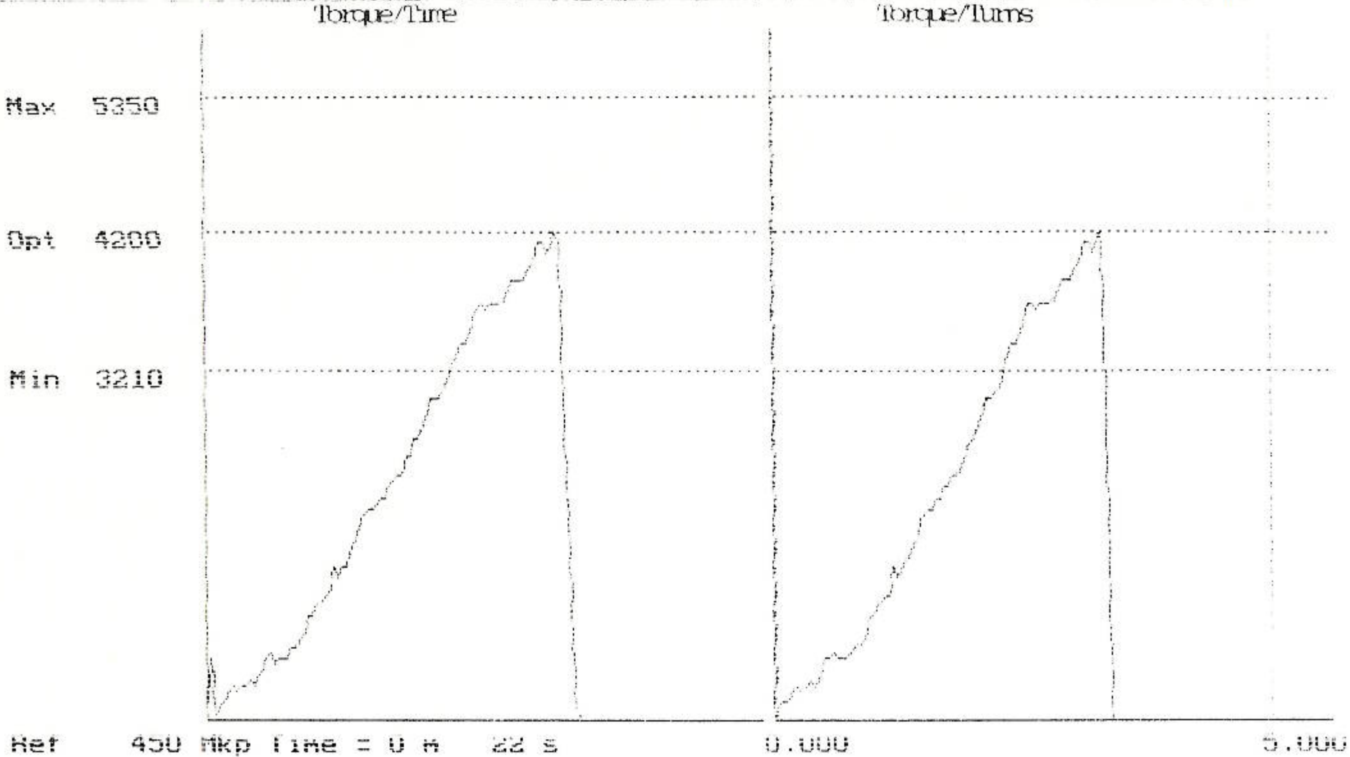


Applied Torque = 4292 Top Turns = 3.314

Comments:OK TU

WEATHERFORD JAM SERVICES

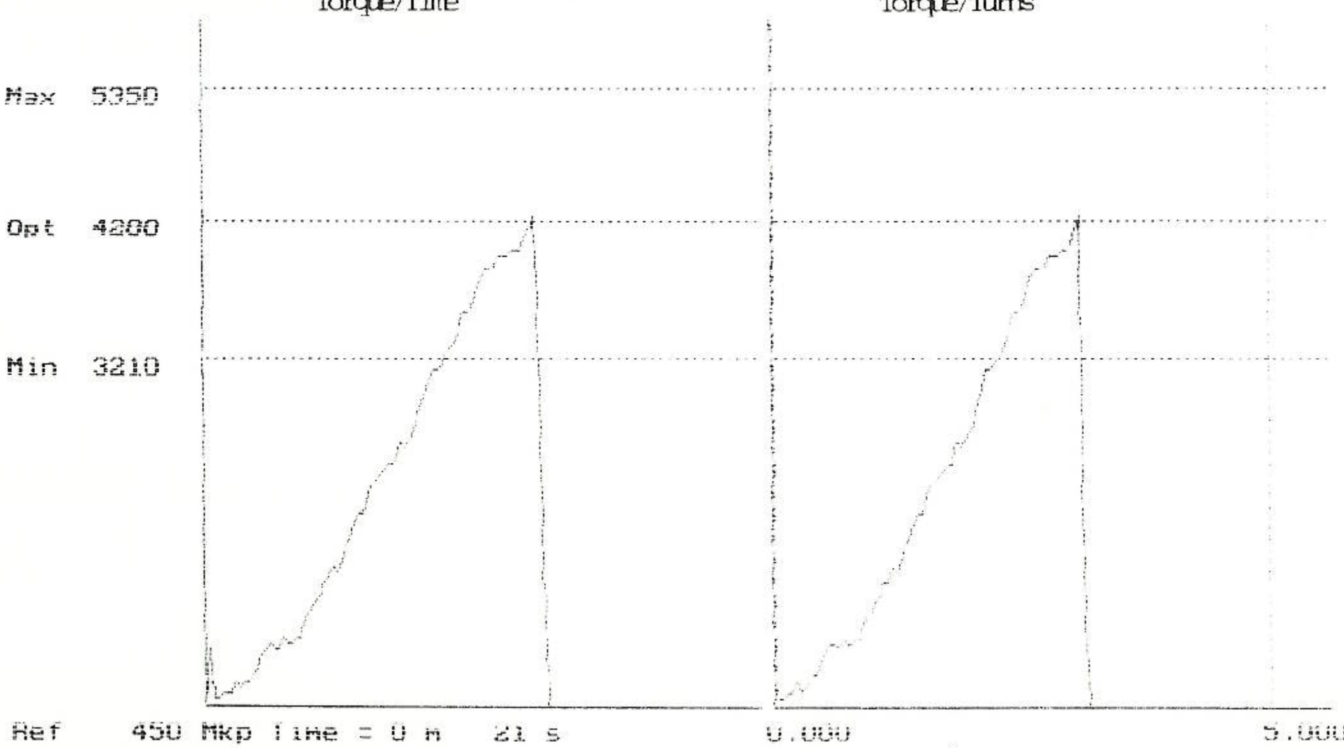
16:26 03/07/94 ACCEPT Joint # = 25 Log # = 25 Red String LTC 5 1/2 20# N-80



Applied Torque = 4292 Top Turns = 3.315

Comments:OK TU

16:29 03/07/94 ACCEPT Joint # = 26 Log # = 26 Red String LTC 5 1/2 20# N-80

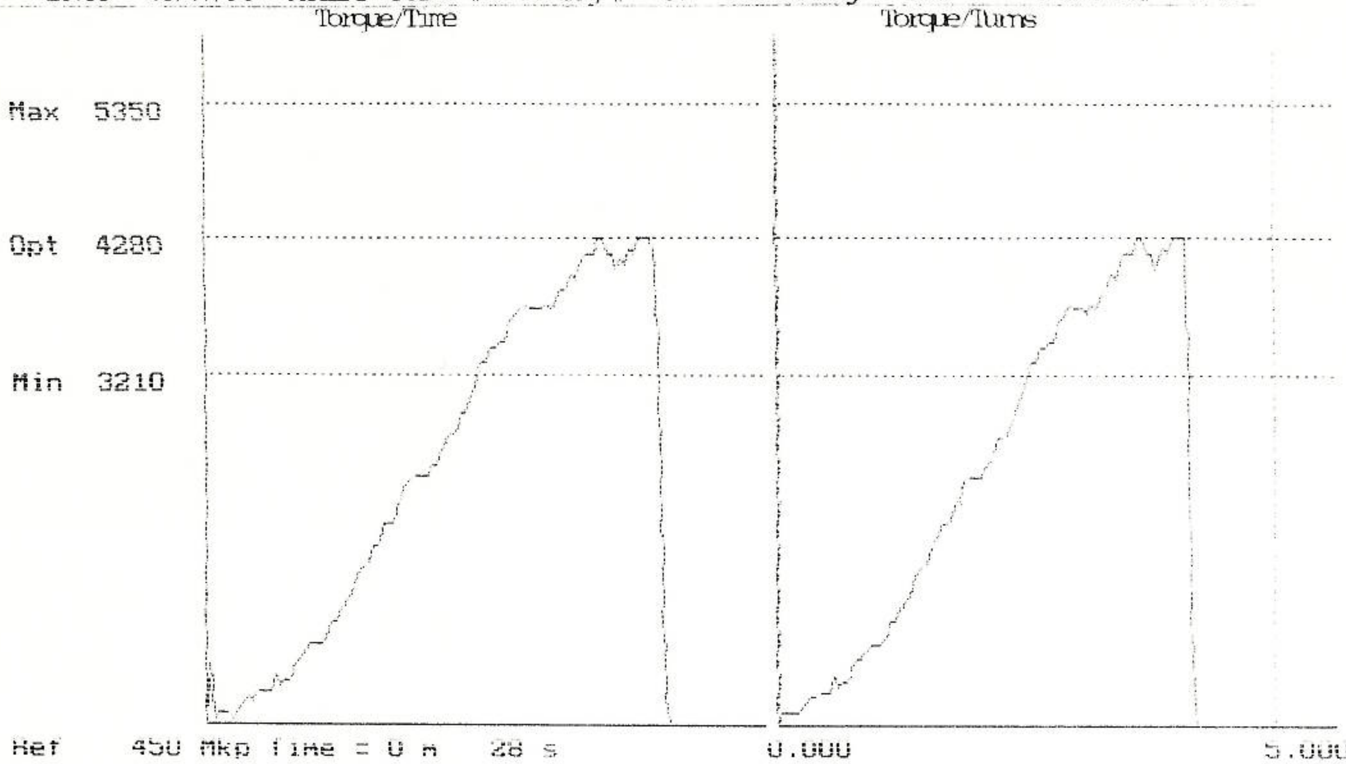


Applied Torque = 4312 Top Turns = 3.097

Comments:OK TU

WEATHERFORD JAM SERVICES

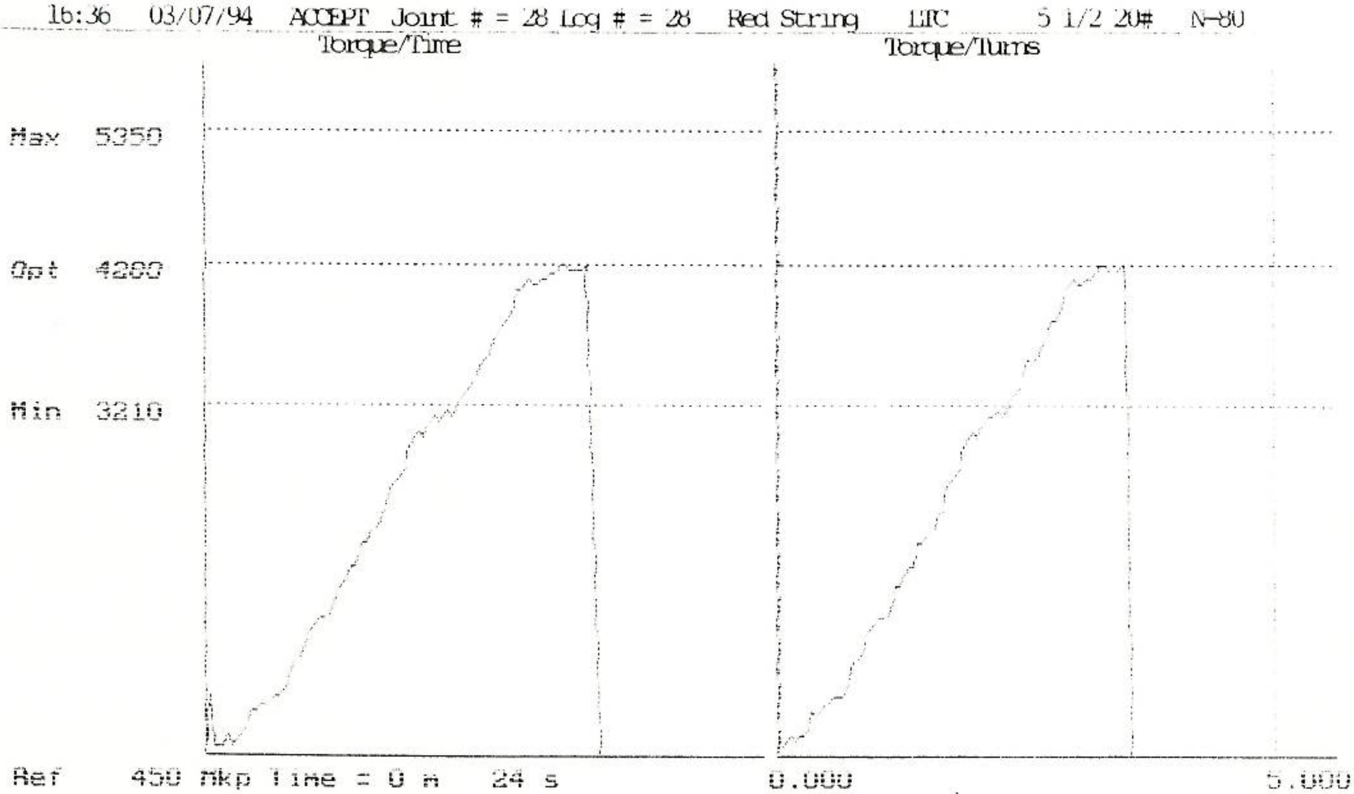
16:33 03/07/94 ACCEPT Joint # = 27 Log # = 27 Red String LTC 5 1/2 20# N-80



Applied Torque = 4292 Top Turns = 4.131

Comments:OK TU

16:36 03/07/94 ACCEPT Joint # = 28 Log # = 28 Red String LTC 5 1/2 20# N-80

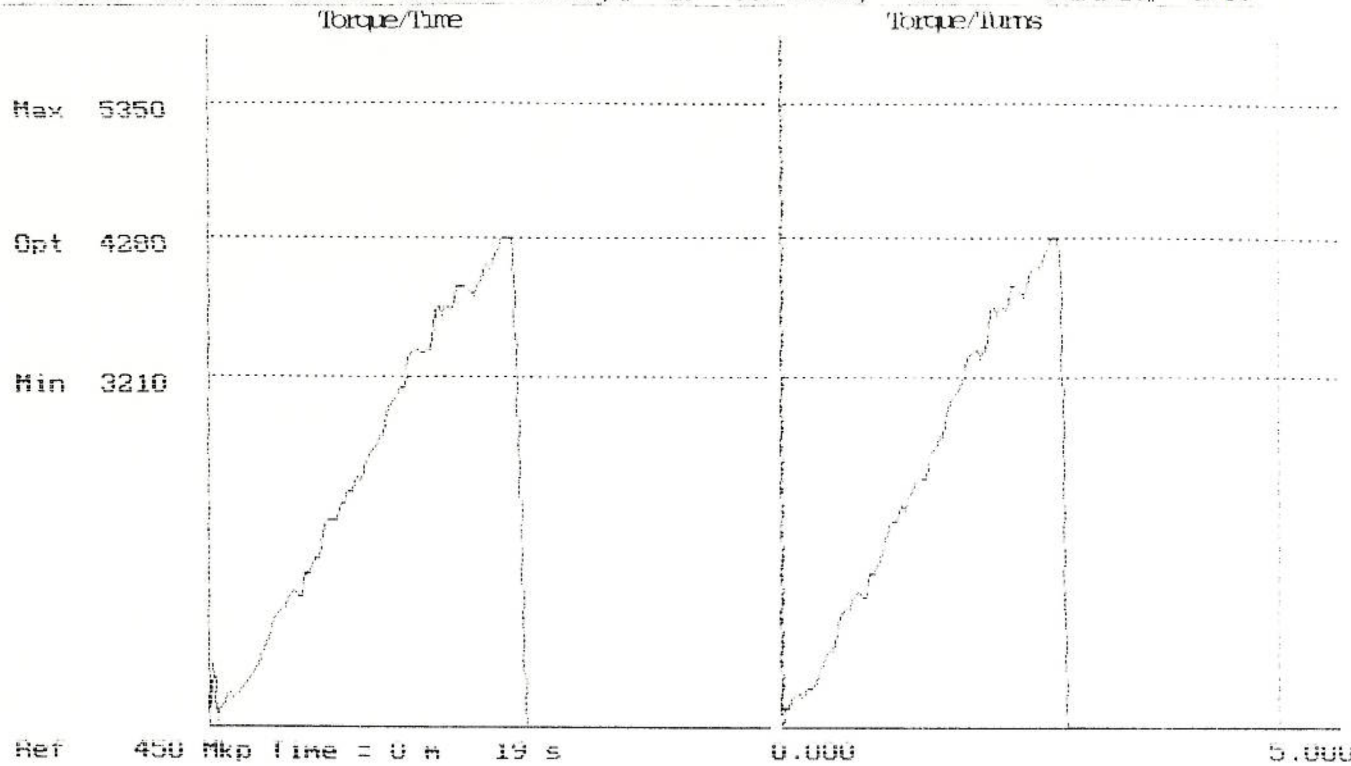


Applied Torque = 4285 Top Turns = 3.496

Comments:OK TU

WEATHERFORD JAM SERVICES

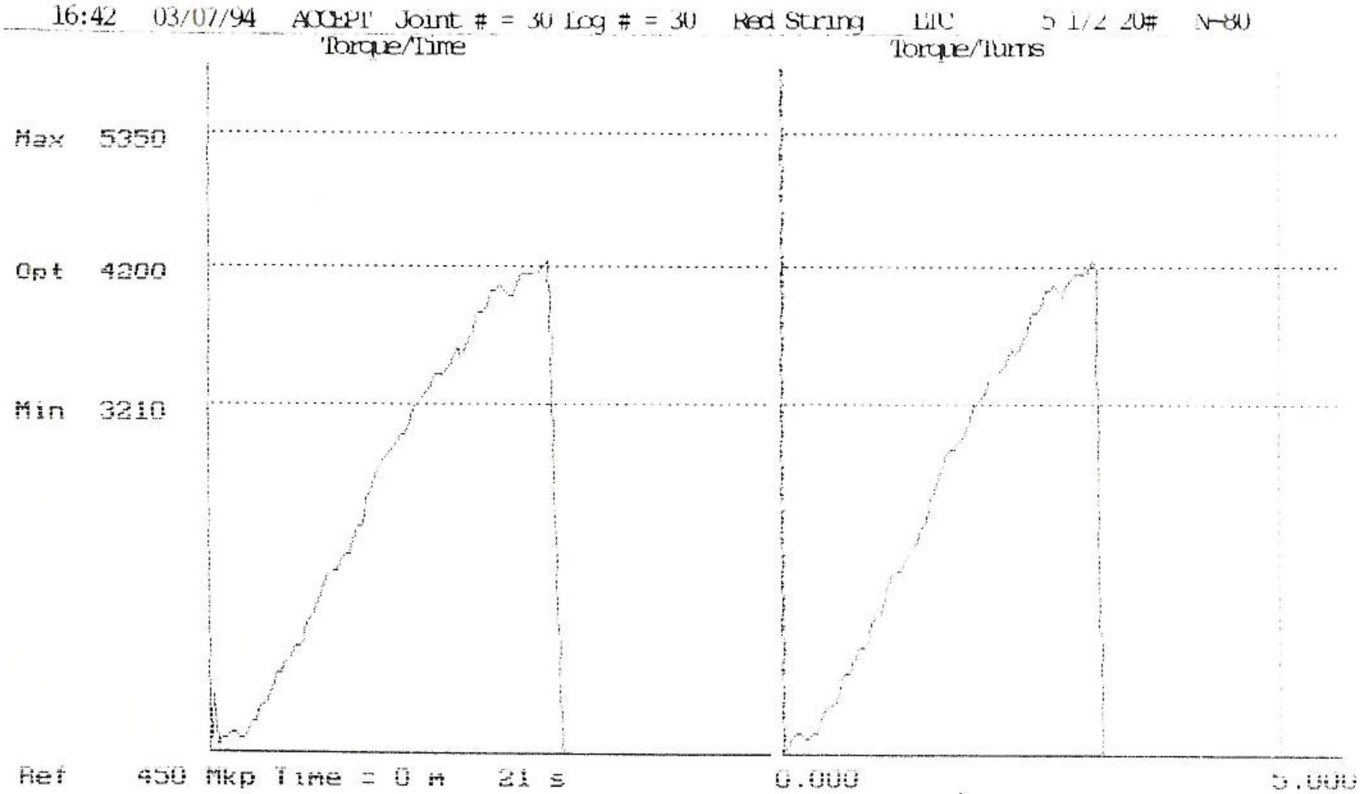
16:39 03/07/94 ACCEPT Joint # = 29 Log # = 29 Red String LTC 5 1/2 20# N-80



Applied Torque = 4292 Top Turns = 2.803

Comments:OK TU

16:42 03/07/94 ACCEPT Joint # = 30 Log # = 30 Red String LTC 5 1/2 20# N-80

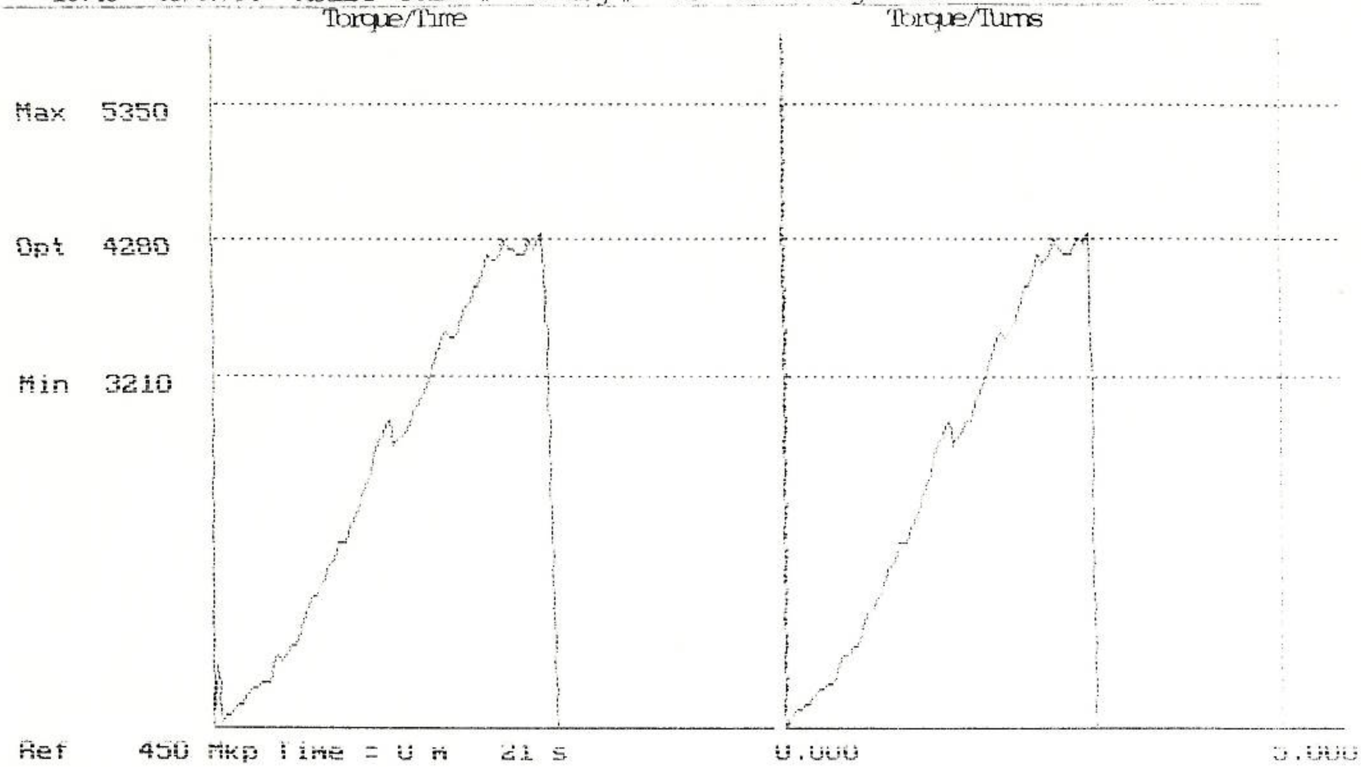


Applied Torque = 4318 Top Turns = 3.156

Comments:OK TU

WEATHERFORD JAM SERVICES

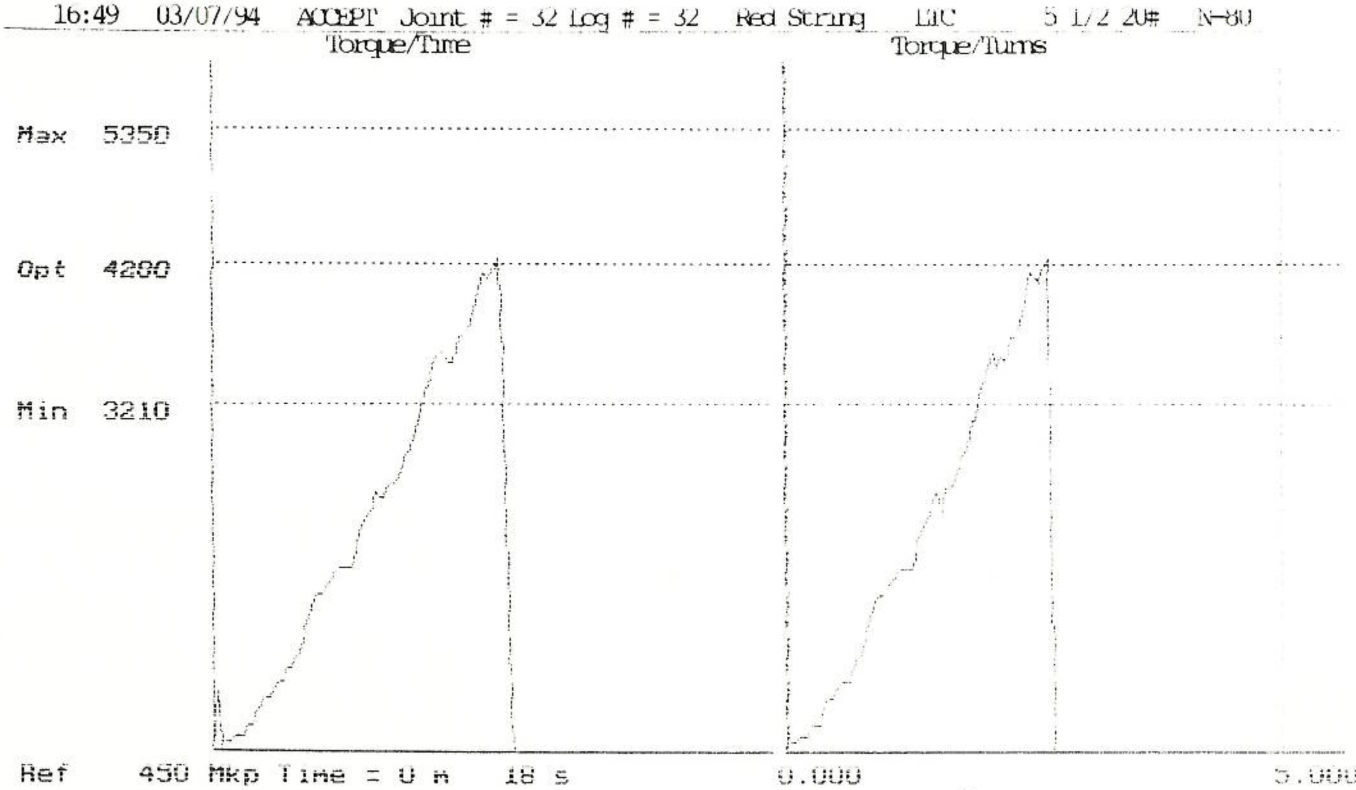
16:46 03/07/94 ACCEPT Joint # = 31 Log # = 31 Red String LTC 5 1/2 20# N-80



Applied Torque = 4332 Top Turns = 3.093

Comments:OK TU

16:49 03/07/94 ACCEPT Joint # = 32 Log # = 32 Red String LTC 5 1/2 20# N-80

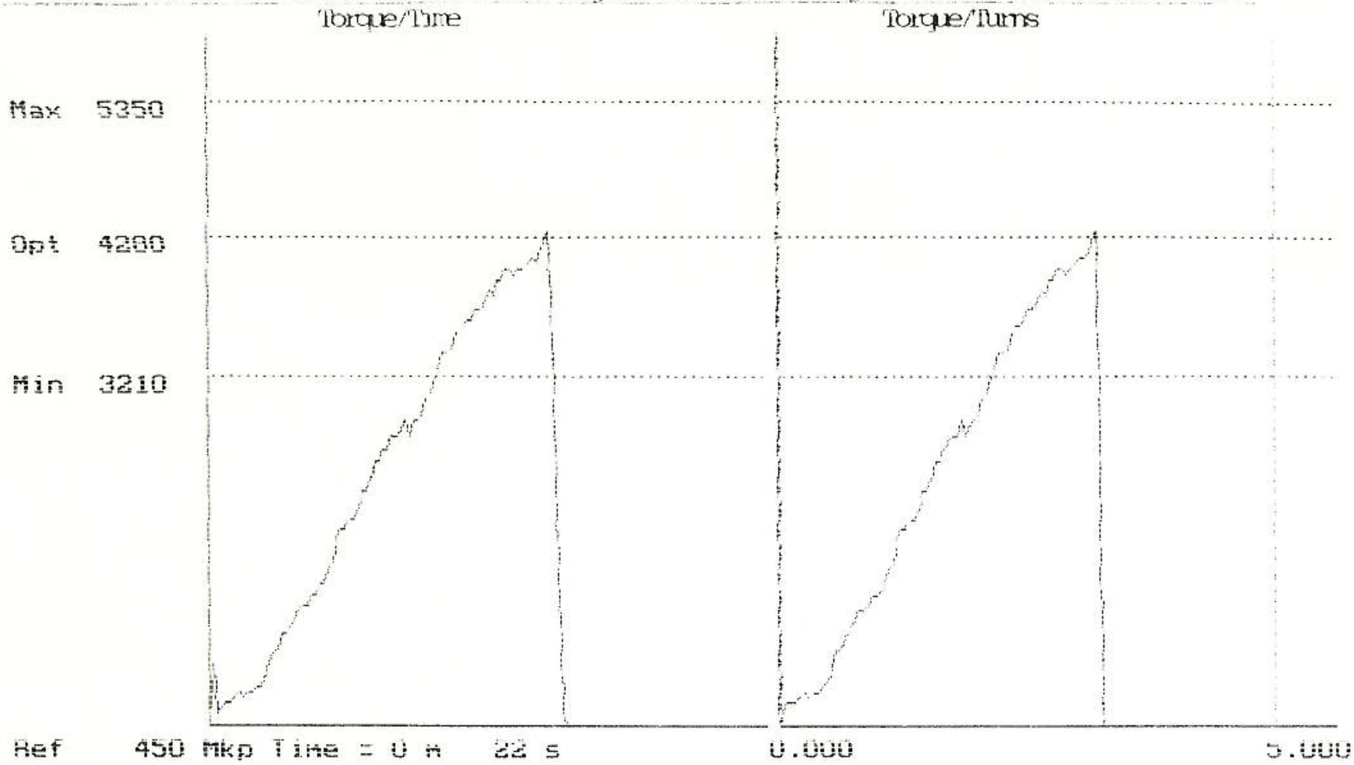


Applied Torque = 4305 Top Turns = 2.659

Comments:OK TU

WEATHERFORD JAM SERVICES

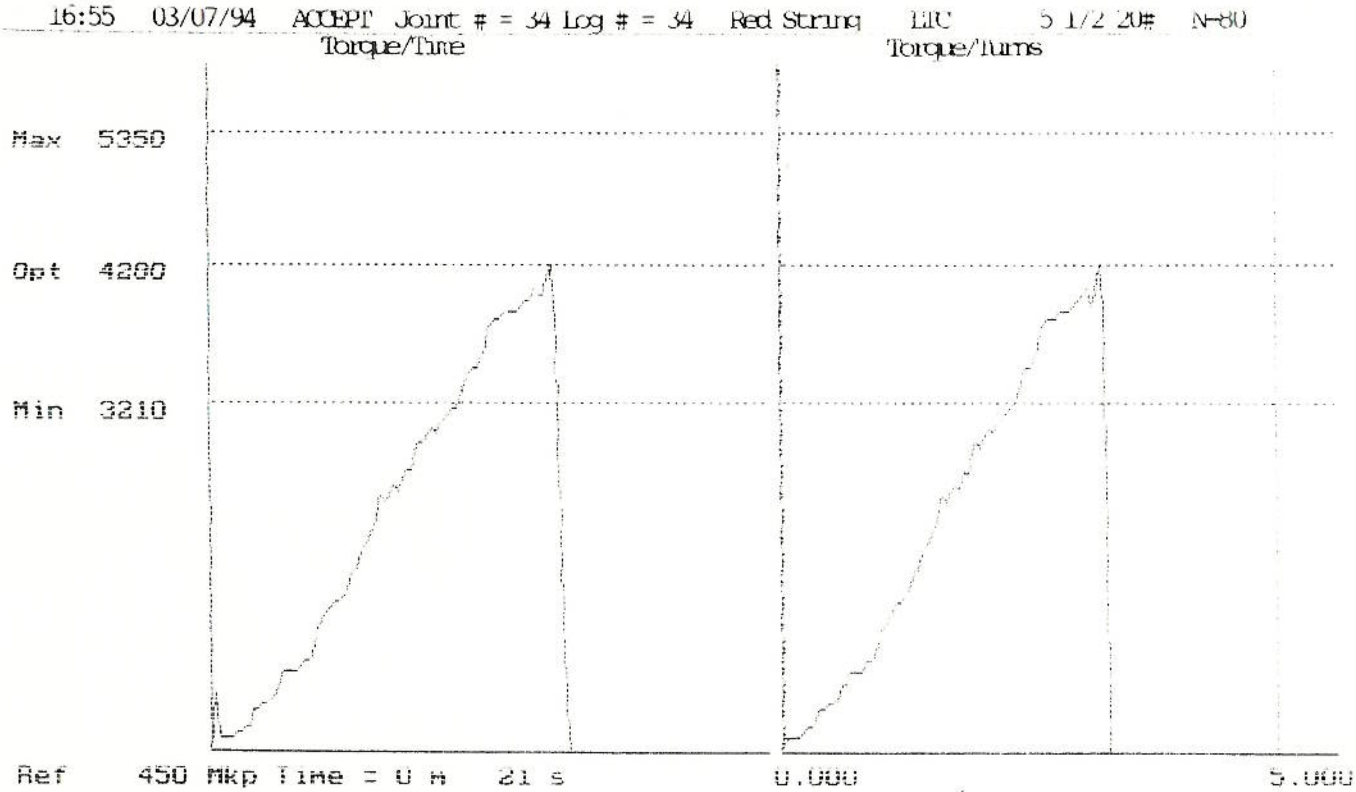
16:52 03/07/94 ACCEPT Joint # = 33 Log # = 33 Red String LTC 5 1/2 20# N-80



Applied Torque = 4332 Top Turns = 3.205

Comments:OK TU

16:55 03/07/94 ACCEPT Joint # = 34 Log # = 34 Red String LTC 5 1/2 20# N-80

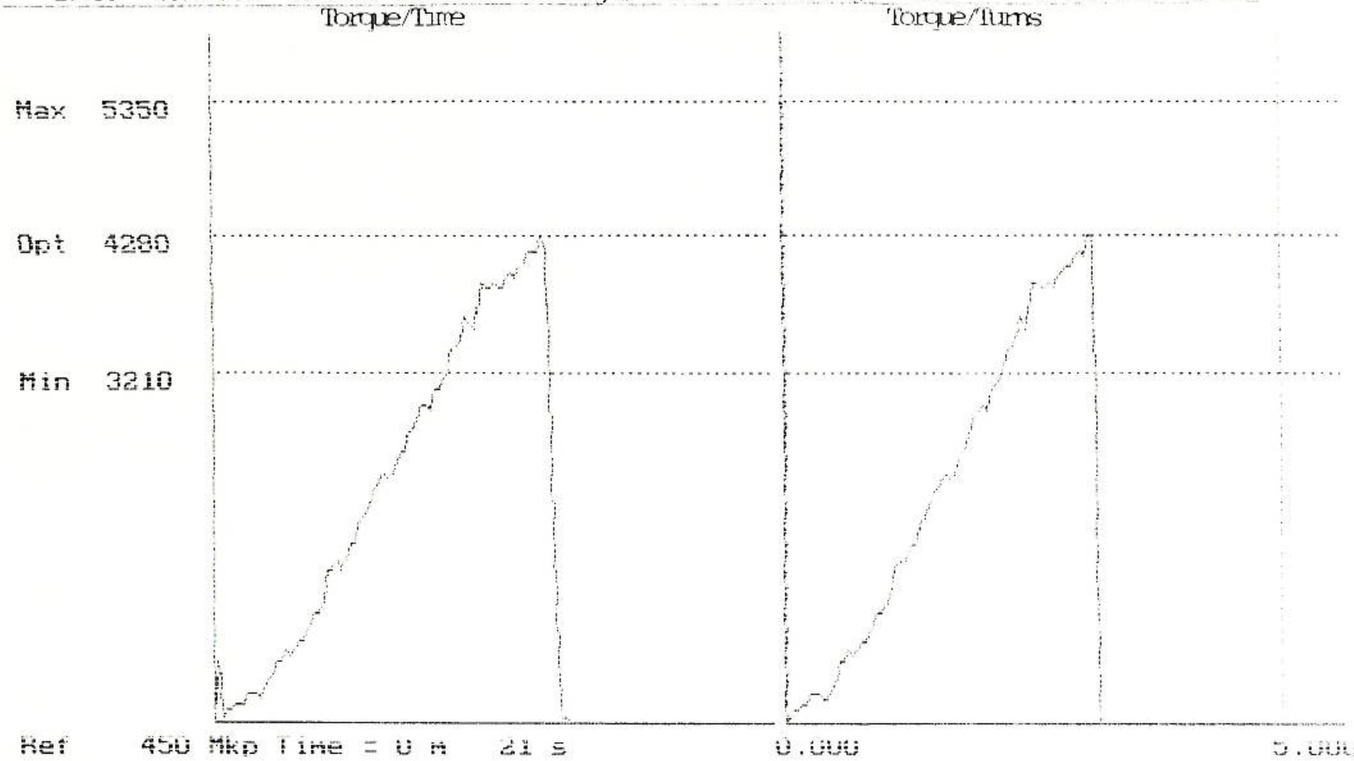


Applied Torque = 4285 Top Turns = 3.237

Comments:OK TU

WEATHERFORD JAM SERVICES

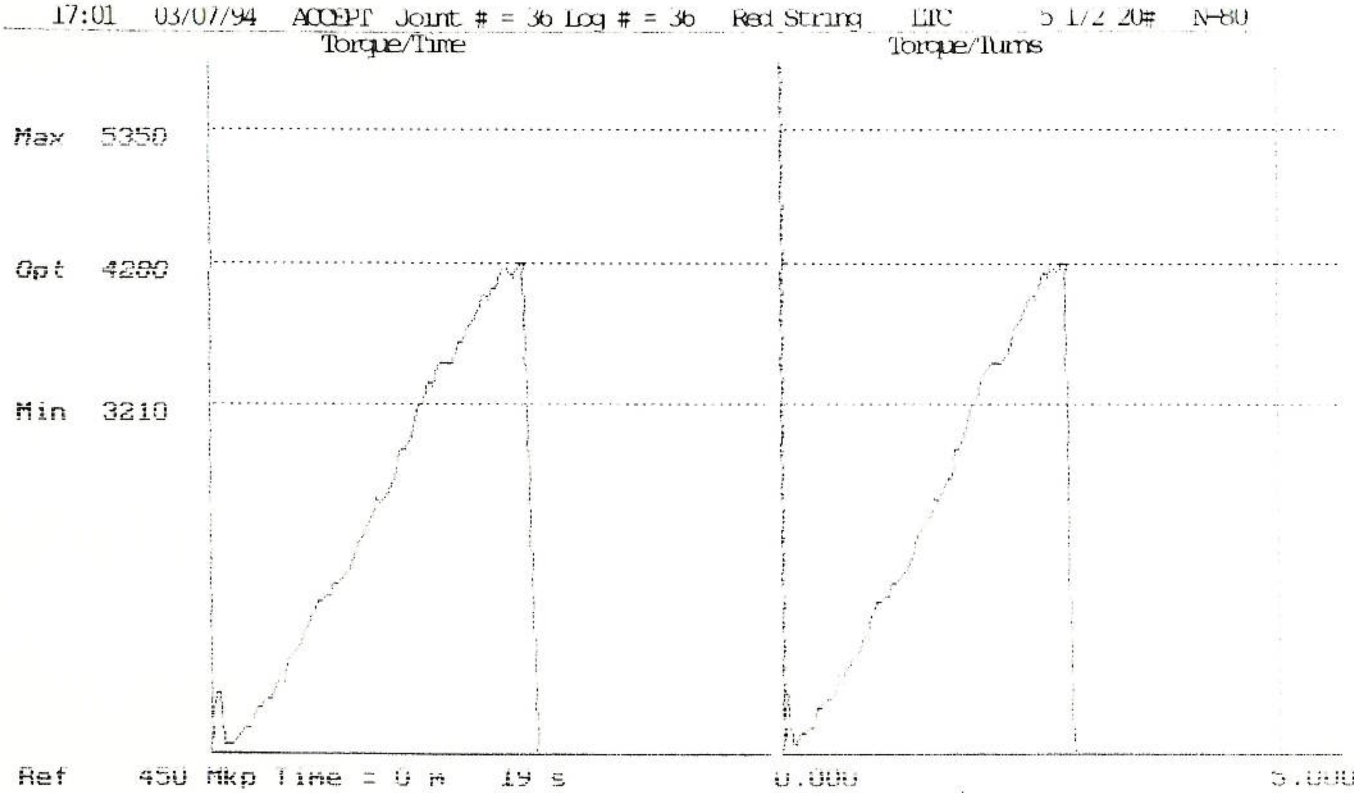
16:58 03/07/94 ACCEPT Joint # = 35 Log # = 35 Red String LTC 5 1/2 20# N-80



Applied Torque = 4292 Top Turns = 3.117

Comments:OK TU

17:01 03/07/94 ACCEPT Joint # = 36 Log # = 36 Red String LTC 5 1/2 20# N-80

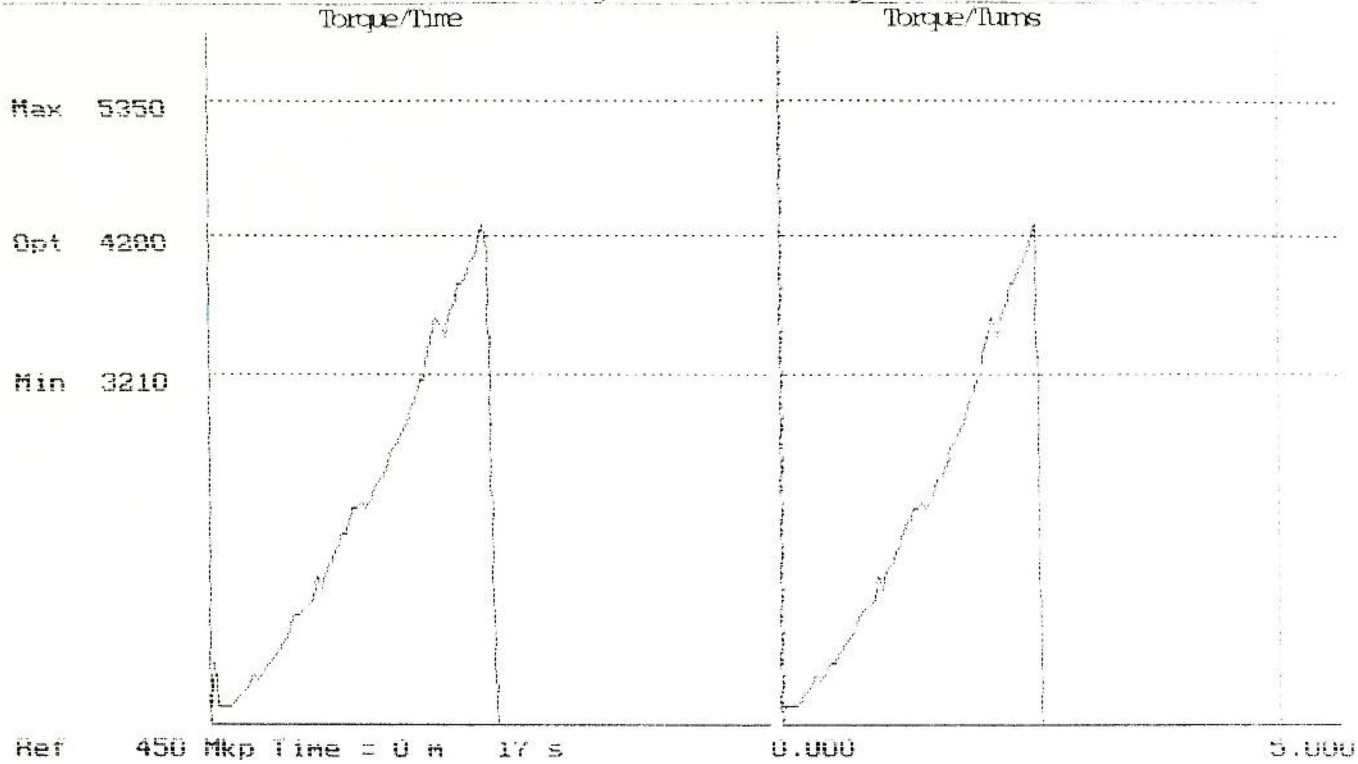


Applied Torque = 4292 Top Turns = 2.881

Comments:OK TU

WEATHERFORD JAM SERVICES

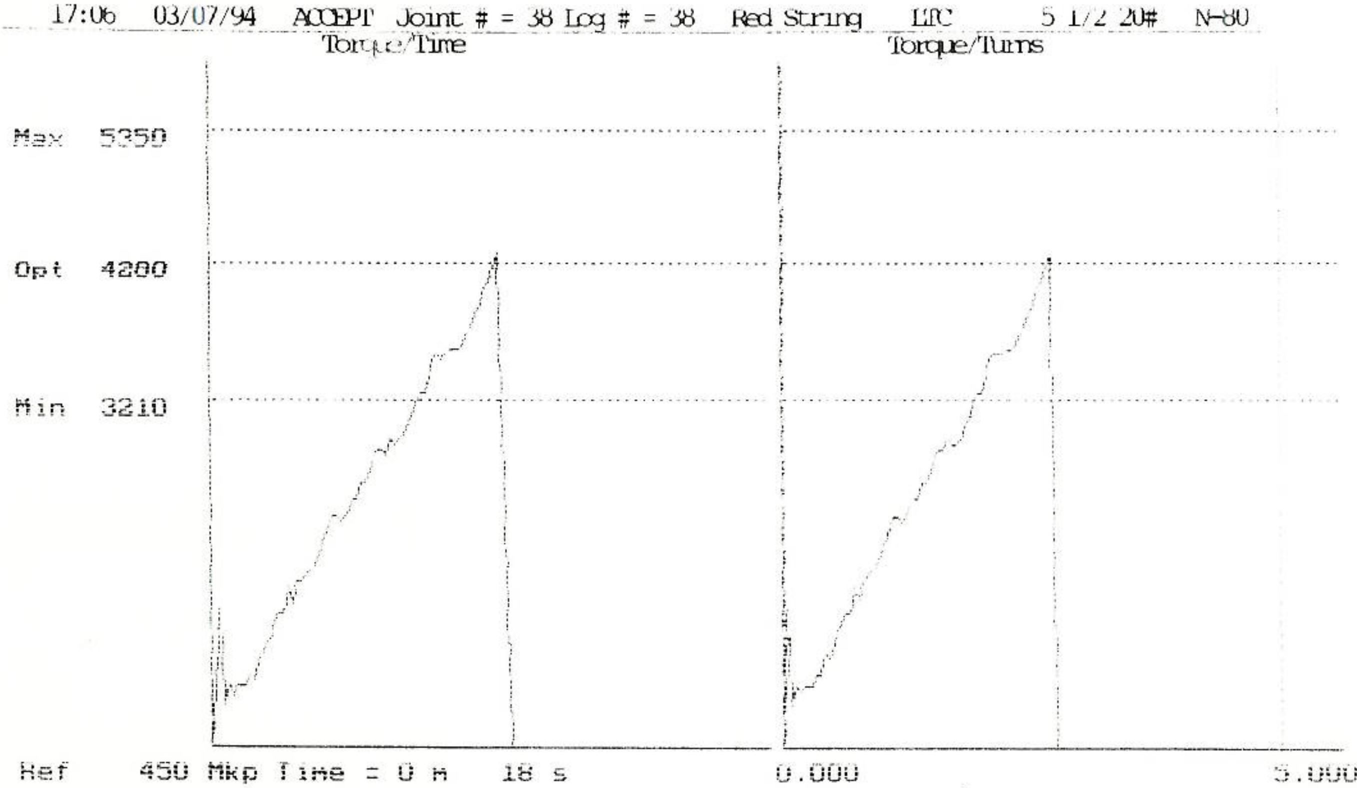
17:04 03/07/94 ACCEPT Joint # = 37 Log # = 37 Red String LTC 5 1/2 20# N-80



Applied Torque = 4358 Top Turns = 2.578

Comments:OK TU

17:06 03/07/94 ACCEPT Joint # = 38 Log # = 38 Red String LTC 5 1/2 20# N-80

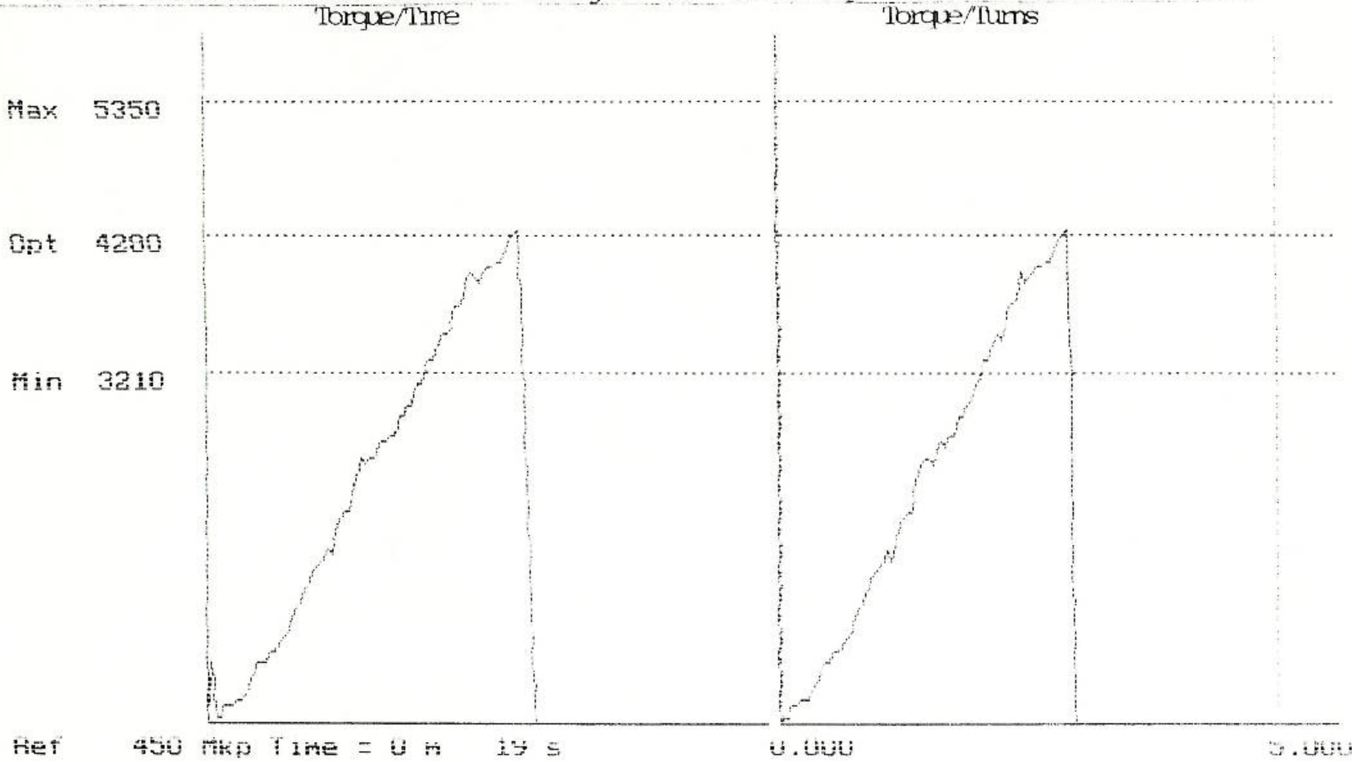


Applied Torque = 4338 Top Turns = 2.691

Comments:OK TU

WEATHERFORD JAM SERVICES

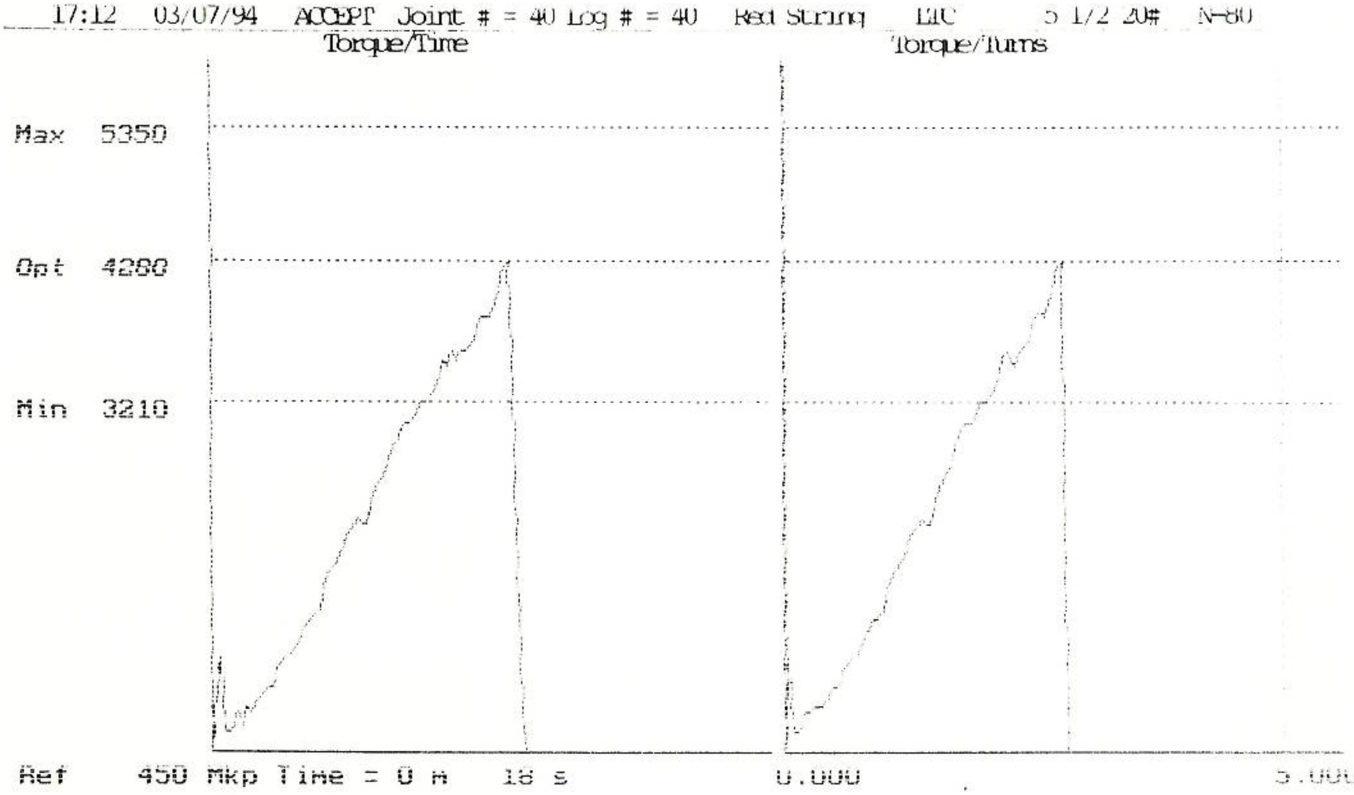
17:09 03/07/94 ACCEPT Joint # = 39 Log # = 39 Red String LTC 5 1/2 20# N-80



Applied Torque = 4298 Top Turns = 2.905

Comments:OK TU

17:12 03/07/94 ACCEPT Joint # = 40 Log # = 40 Red String LTC 5 1/2 20# N-80

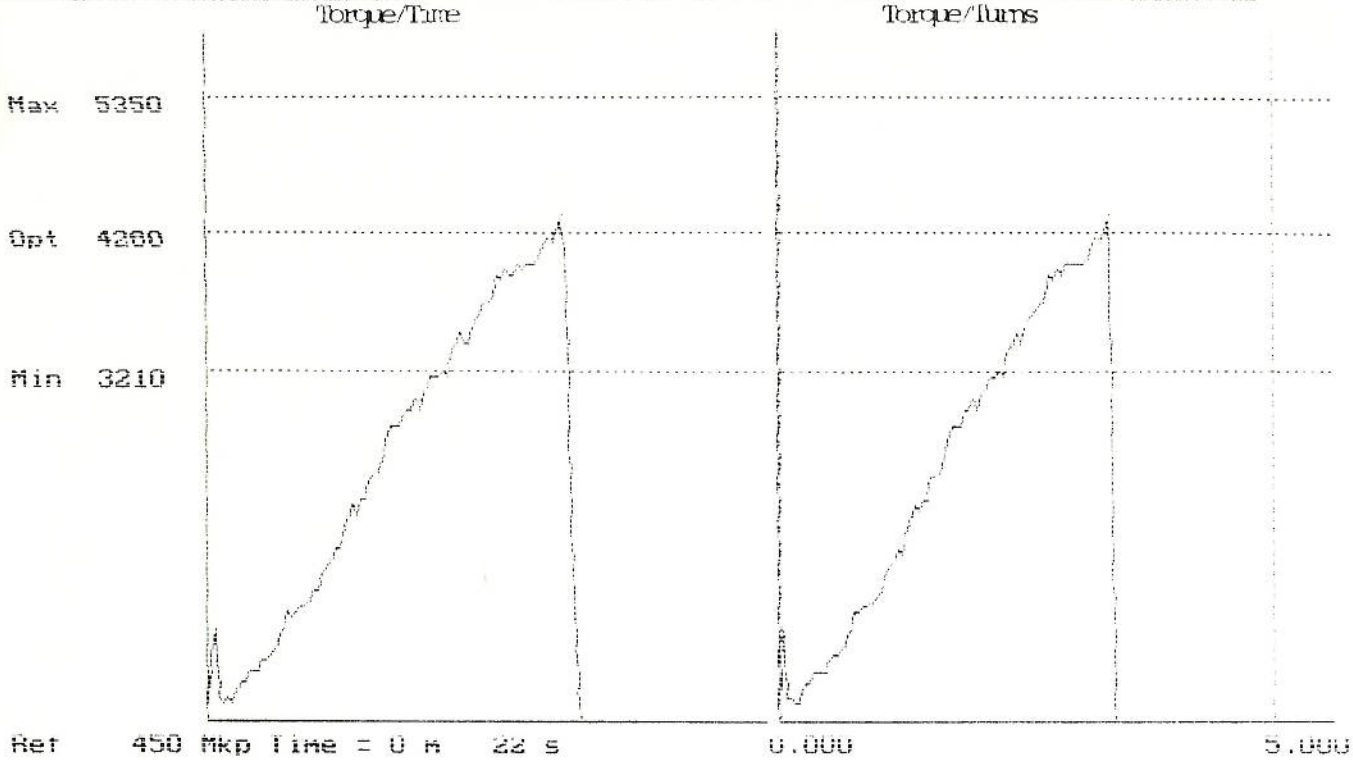


Applied Torque = 4292 Top Turns = 2.785

Comments:OK TU

WEATHERFORD JAM SERVICES

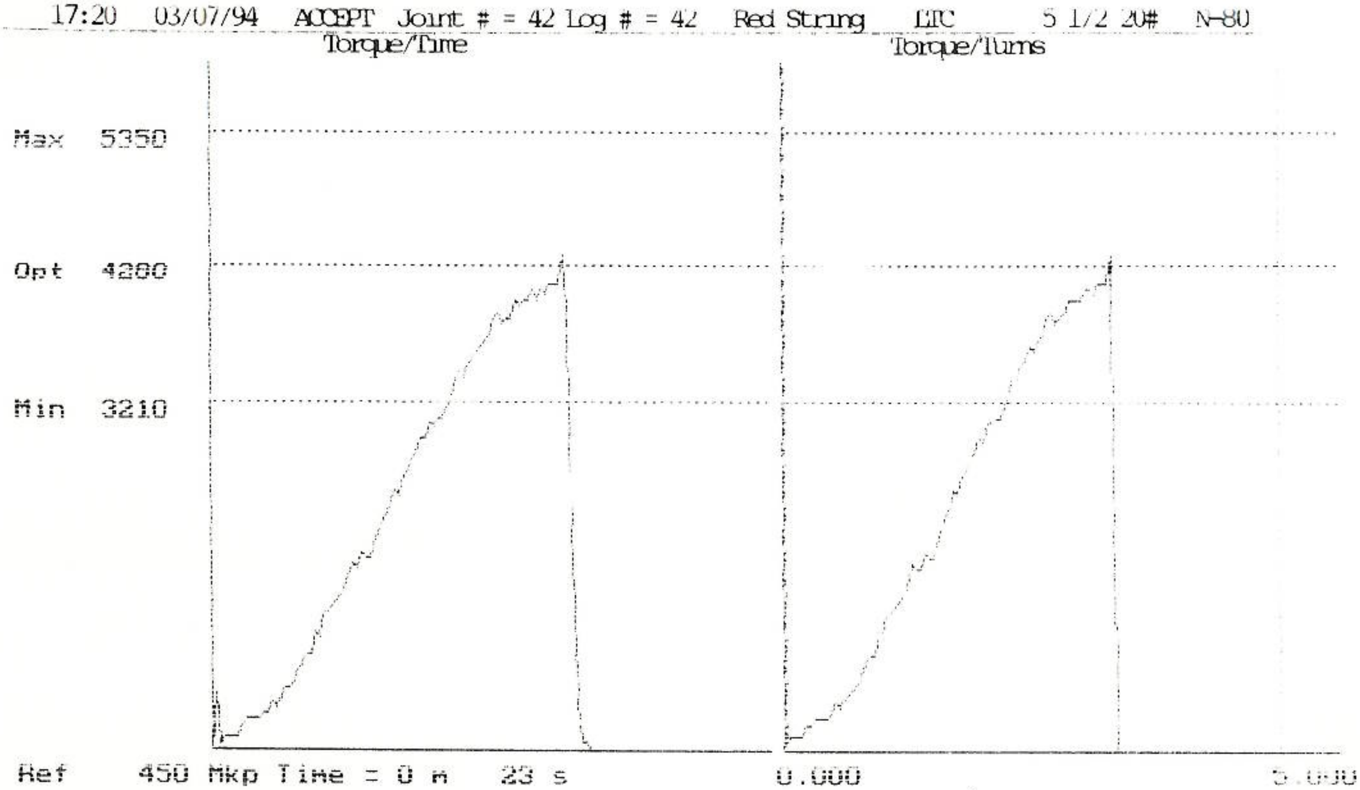
17:17 03/07/94 ACCEPT Joint # = 41 Log # = 41 Red String LTC 5 1/2 20# N-80



Applied Torque = 4385 Top Turns = 3.345

Comments:OK TU

17:20 03/07/94 ACCEPT Joint # = 42 Log # = 42 Red String LTC 5 1/2 20# N-80

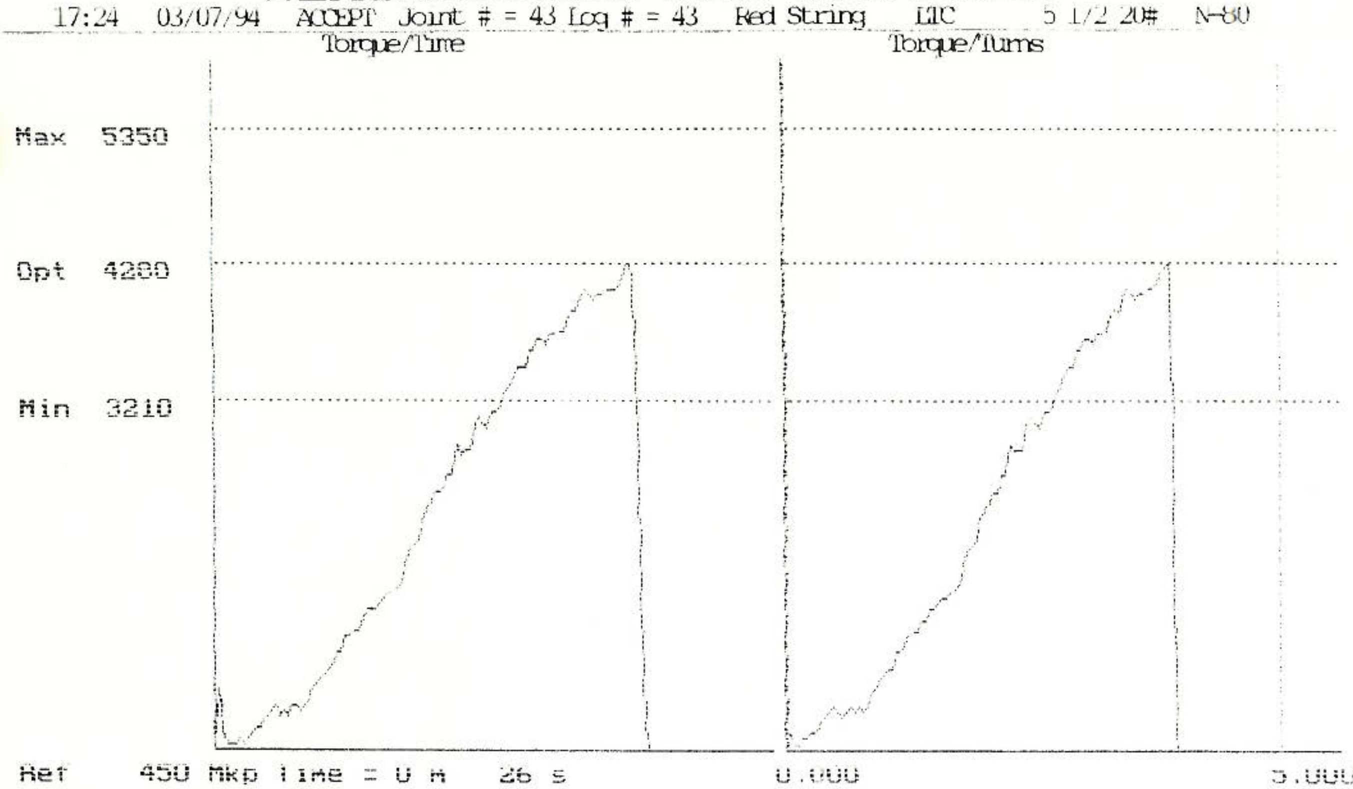


Applied Torque = 4345 Top Turns = 3.298

Comments:OK TU

WEATHERFORD JAM SERVICES

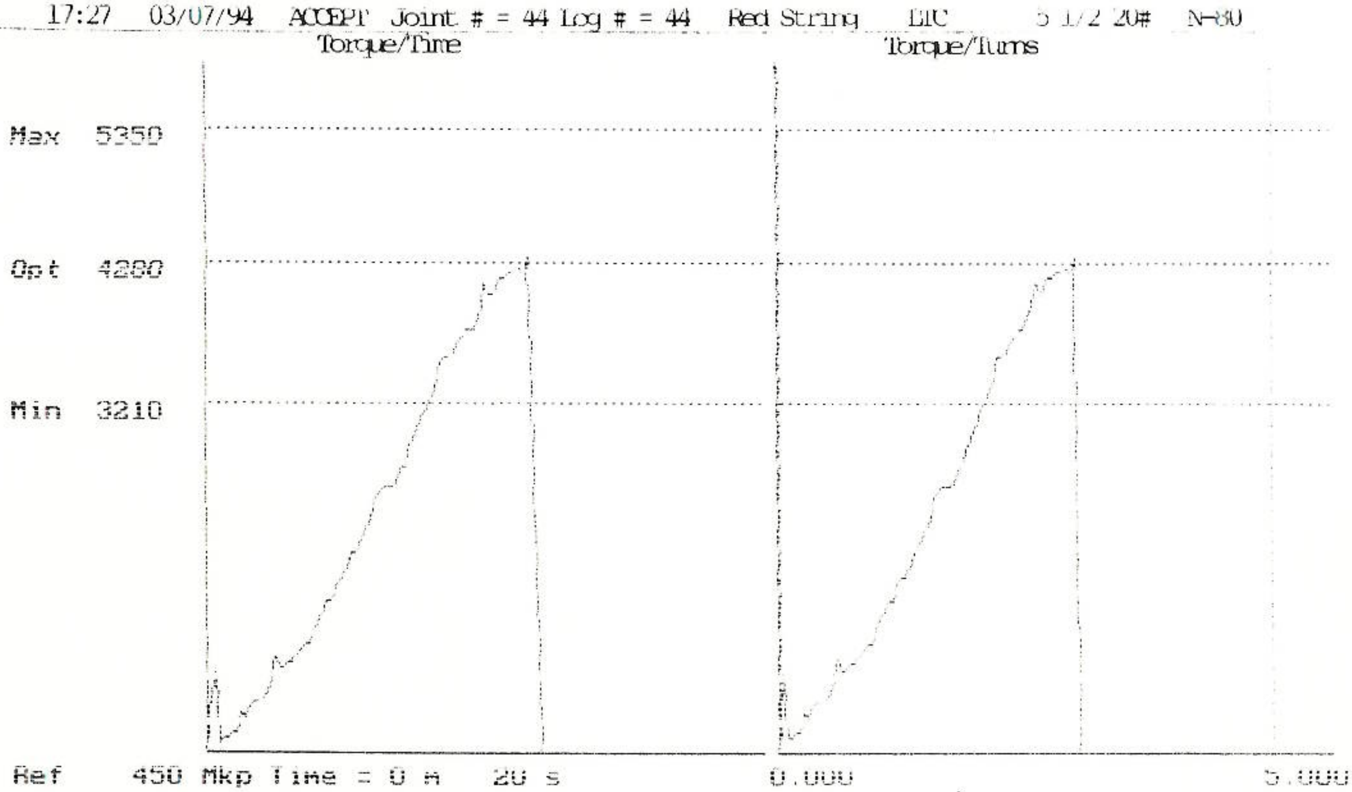
17:24 03/07/94 ACCEPT Joint # = 43 Log # = 43 Red String LTC 5 1/2 20# N-80



Applied Torque = 4285 Top Turns = 3.898

Comments:OK TU

17:27 03/07/94 ACCEPT Joint # = 44 Log # = 44 Red String LTC 5 1/2 20# N-80

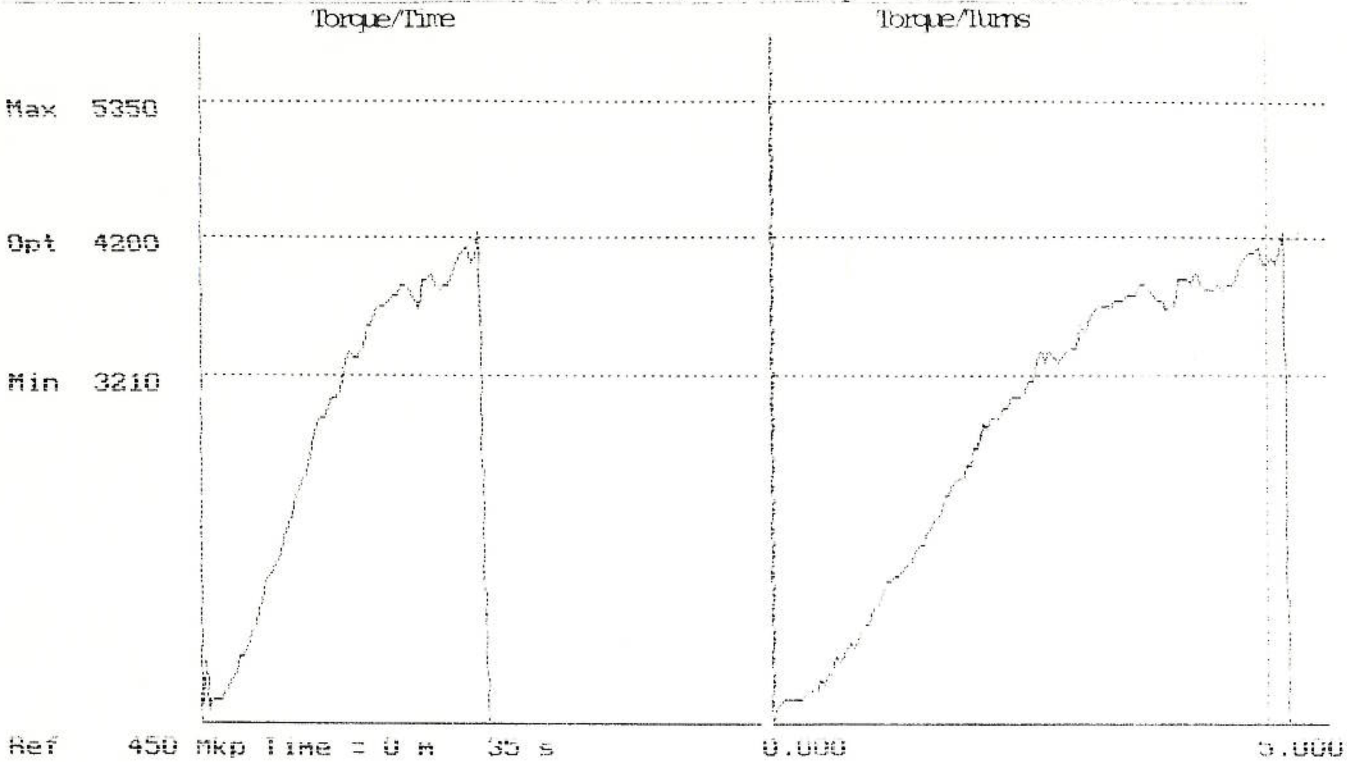


Applied Torque = 4318 Top Turns = 2.995

Comments:OK TU

WEATHERFORD JAM SERVICES

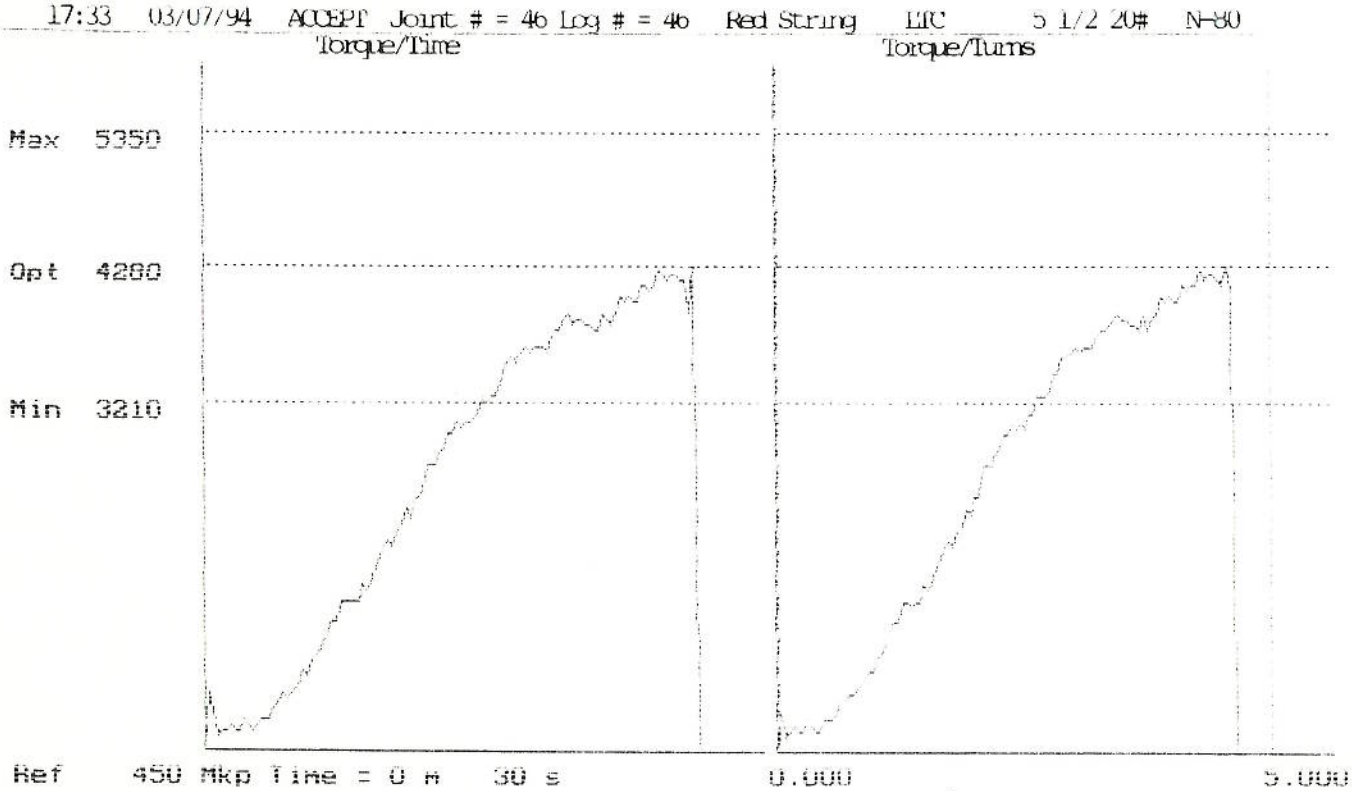
17:30 03/07/94 ACCEPT Joint # = 45 Log # = 45 Red String LTC 5 1/2 20# N-80



Applied Torque = 4325 Top Turns = 5.141

Comments:OK TU

17:33 03/07/94 ACCEPT Joint # = 46 Log # = 46 Red String LTC 5 1/2 20# N-80

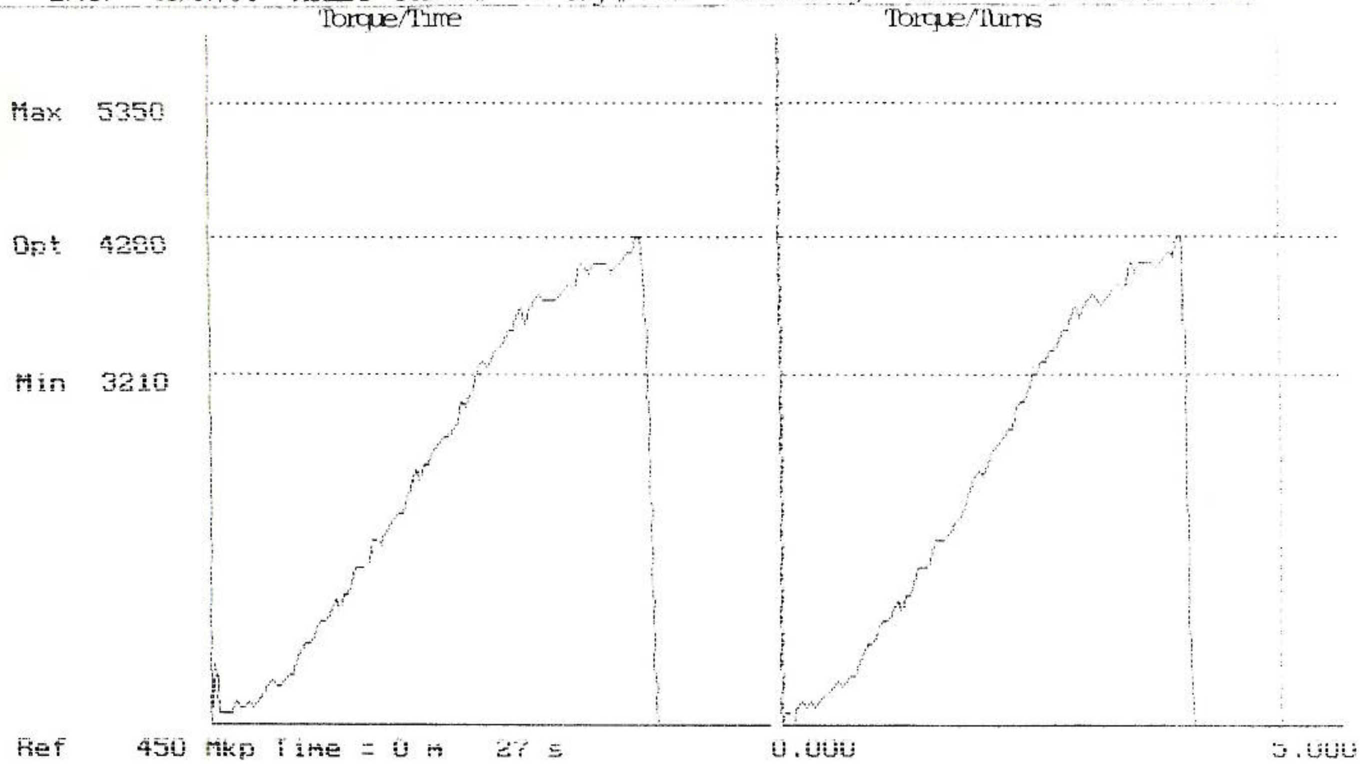


Applied Torque = 4292 Top Turns = 4.562

Comments:OK TU

WEATHERFORD JAM SERVICES

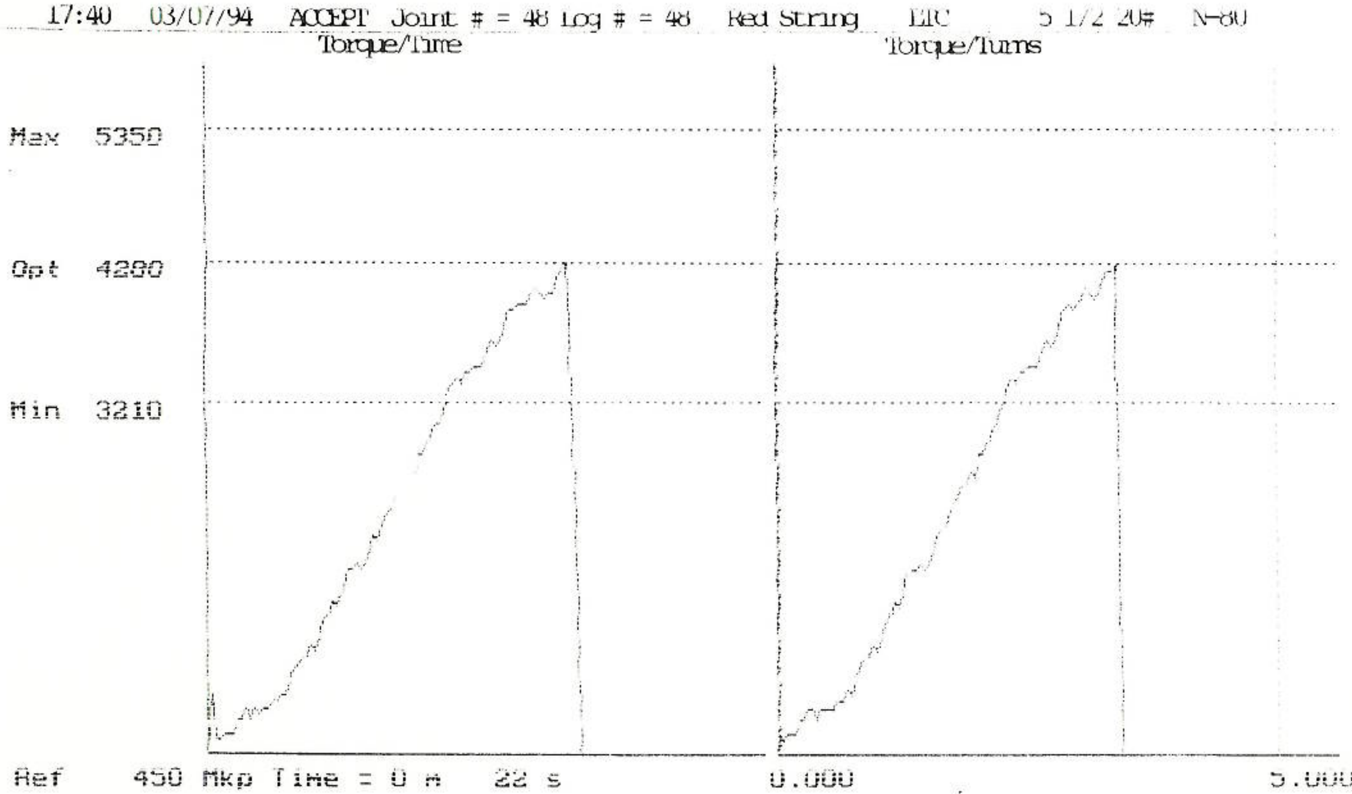
17:37 03/07/94 ACCEPT Joint # = 47 Log # = 47 Red String LTC 5 1/2 20# N-80



Applied Torque = 4292 Top Turns = 4.040

Comments:OK TU

17:40 03/07/94 ACCEPT Joint # = 48 Log # = 48 Red String LTC 5 1/2 20# N-80

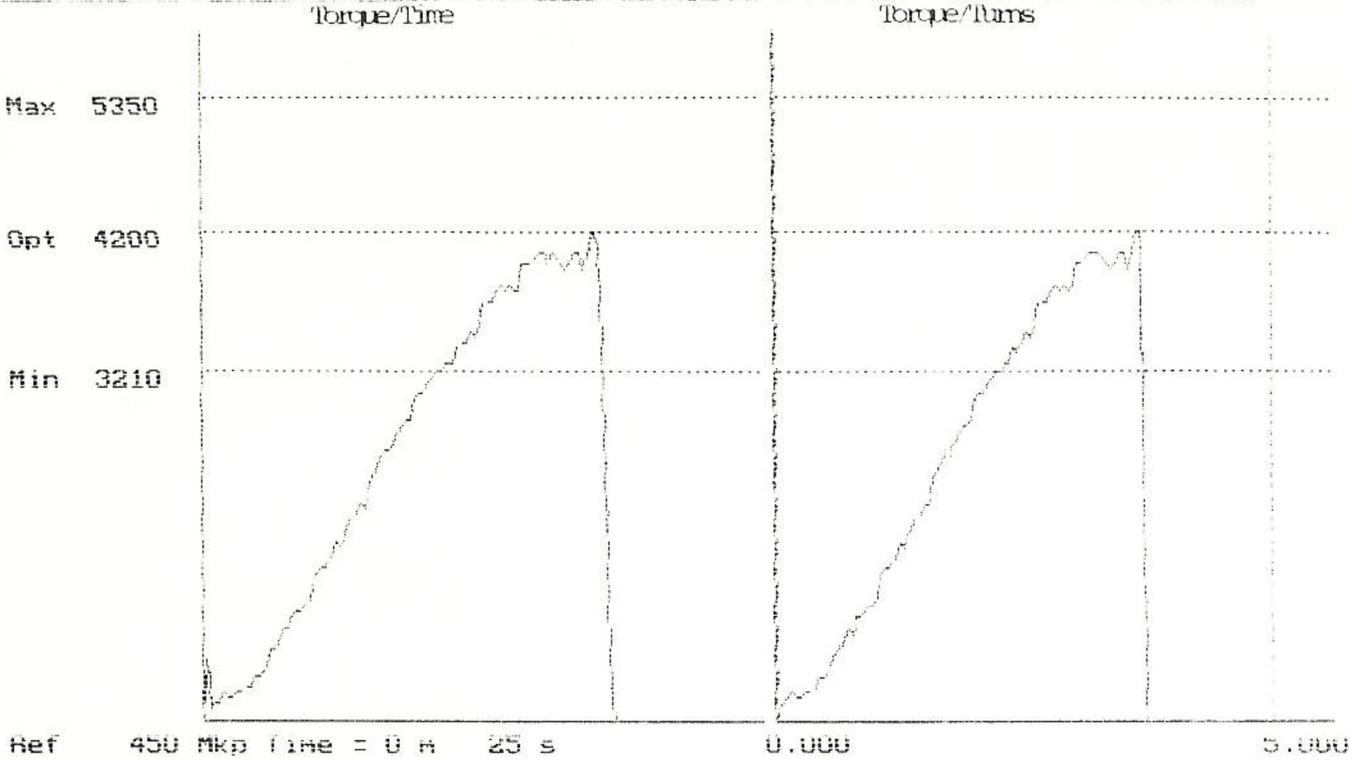


Applied Torque = 4285 Top Turns = 3.380

Comments:OK TU

WEATHERFORD JAM SERVICES

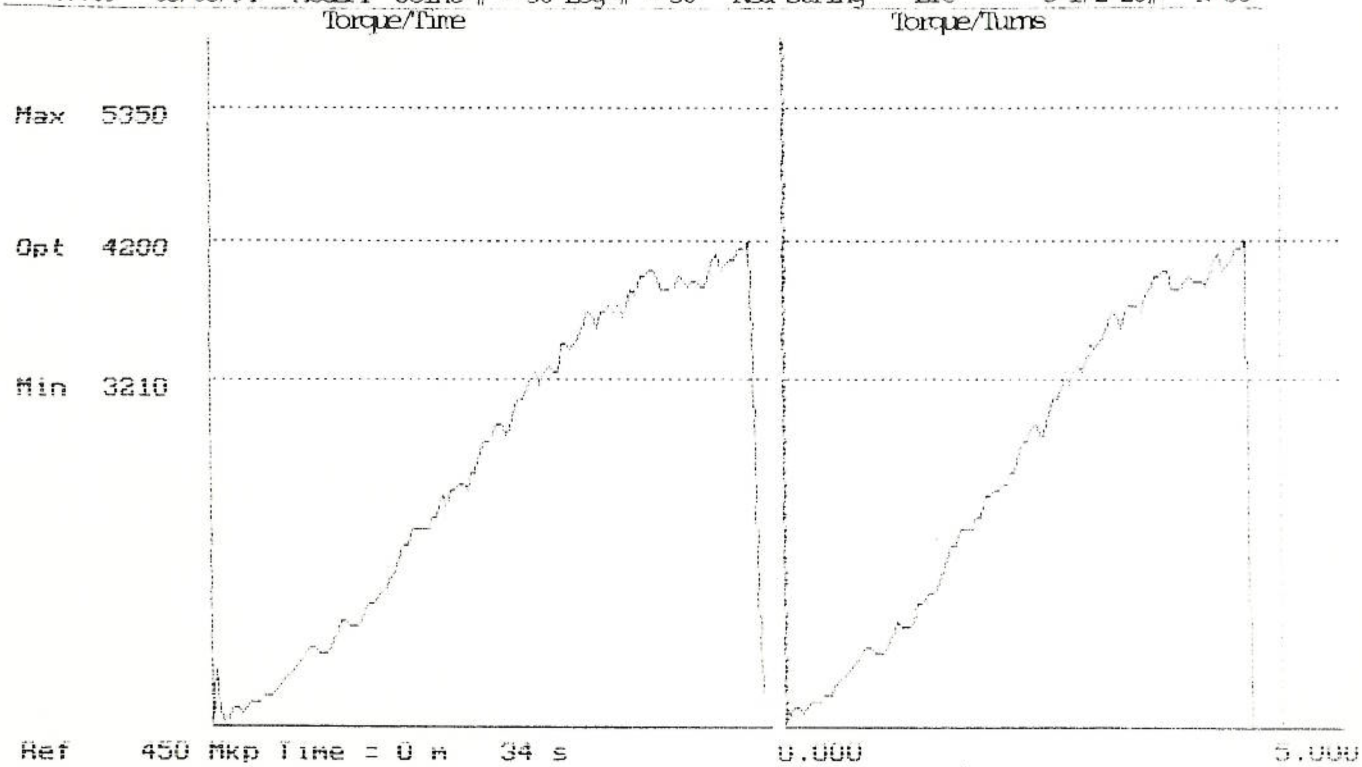
17:43 03/07/94 ACCEPT Joint # = 49 Log # = 49 Red String LTC 5 1/2 20# N-80



Applied Torque = 4292 Top Turns = 3.691

Comments:OK TU

07:09 03/08/94 ACCEPT Joint # = 50 Log # = 50 Red String LTC 5 1/2 20# N-80

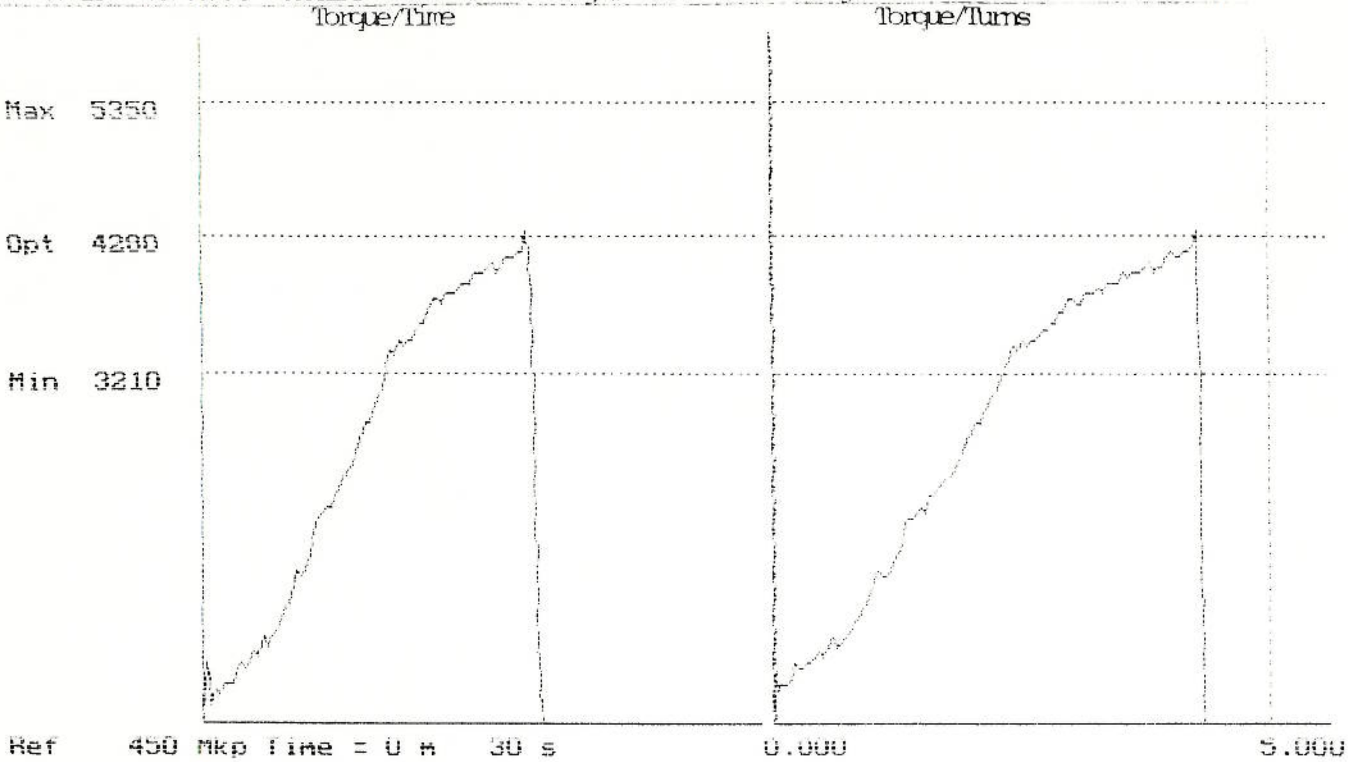


Applied Torque = 4285 Top Turns = 4.632

Comments:OK TU

WEATHERFORD JAM SERVICES

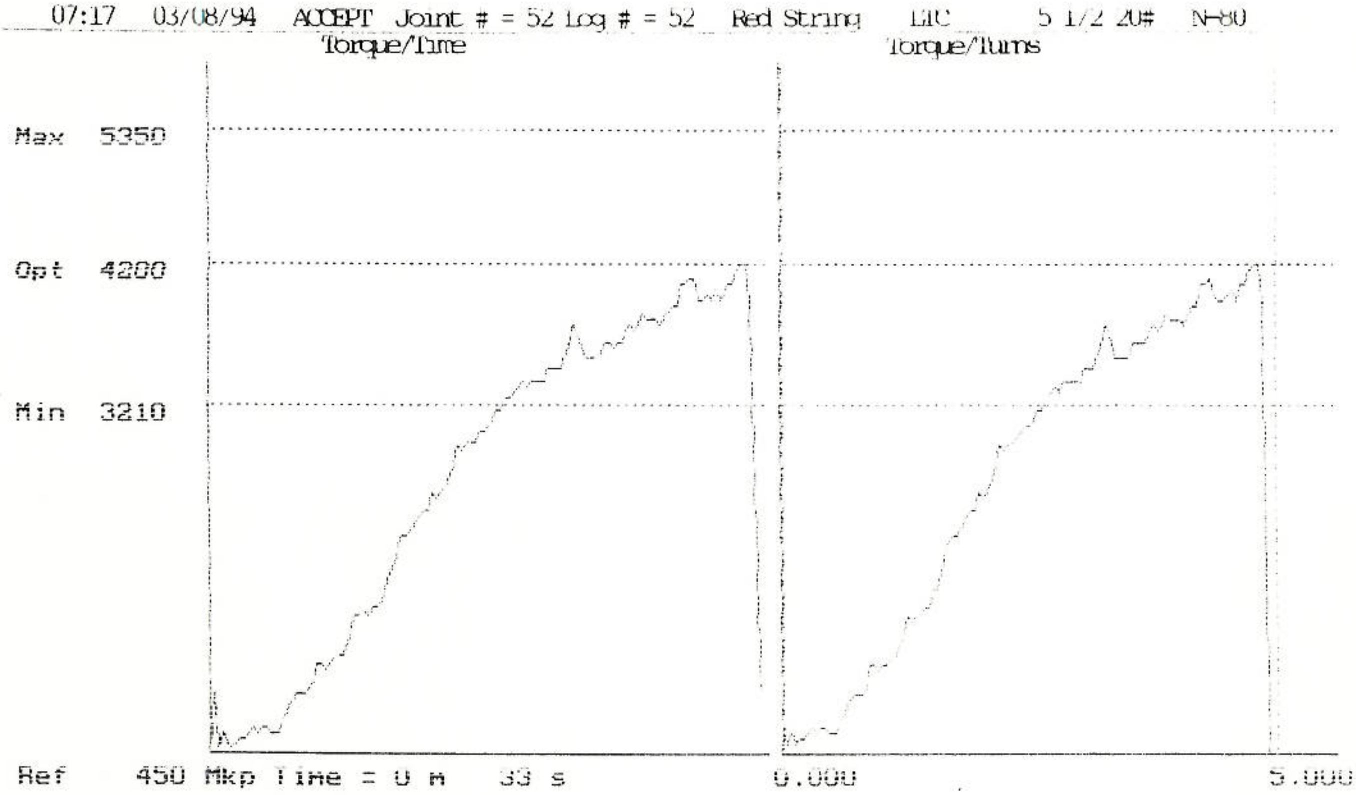
07:13 03/08/94 ACCEPT Joint # = 51 Log # = 51 Red String LTC 5 1/2 20# N-80



Applied Torque = 4314 Top Turns = 4.293

Comments:OK TU

07:17 03/08/94 ACCEPT Joint # = 52 Log # = 52 Red String LTC 5 1/2 20# N-80

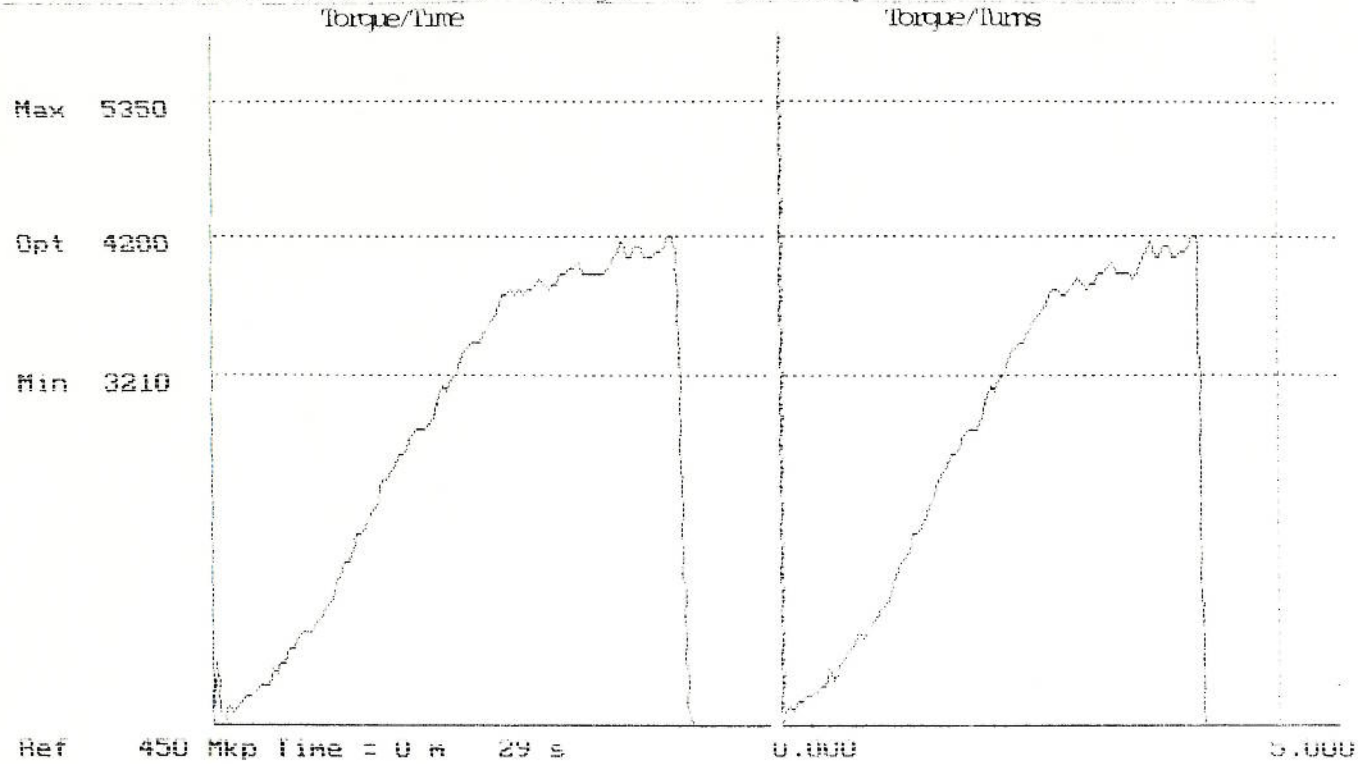


Applied Torque = 4285 Top Turns = 4.826

Comments:OK TU

WEATHERFORD JAM SERVICES

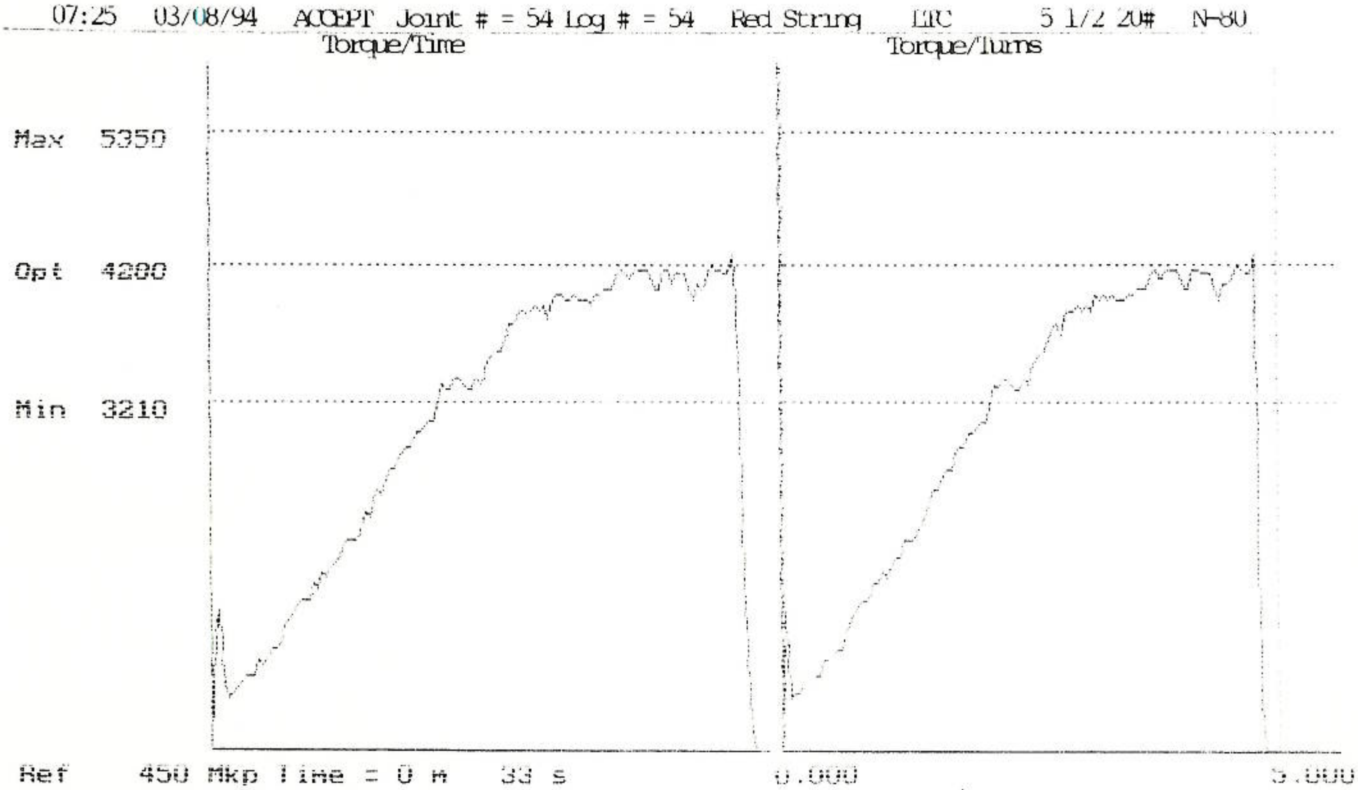
07:22 03/08/94 ACCEPT Joint # = 53 Log # = 53 Red String LTC 5 1/2 20# N-80



Applied Torque = 4285 Top Turns = 4.199

Comments:OK TU

07:25 03/08/94 ACCEPT Joint # = 54 Log # = 54 Red String LTC 5 1/2 20# N-80

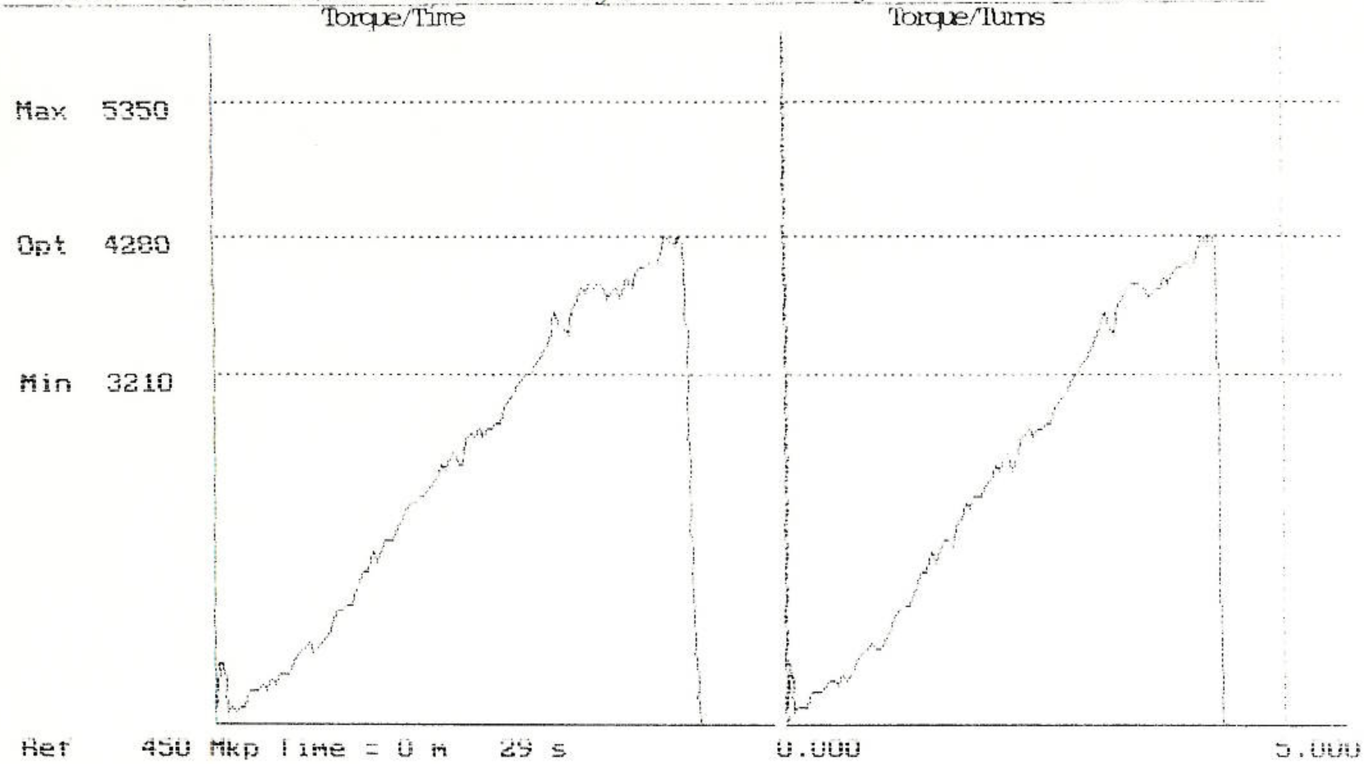


Applied Torque = 4345 Top Turns = 4.772

Comments:OK TU

WEATHERFORD JAM SERVICES

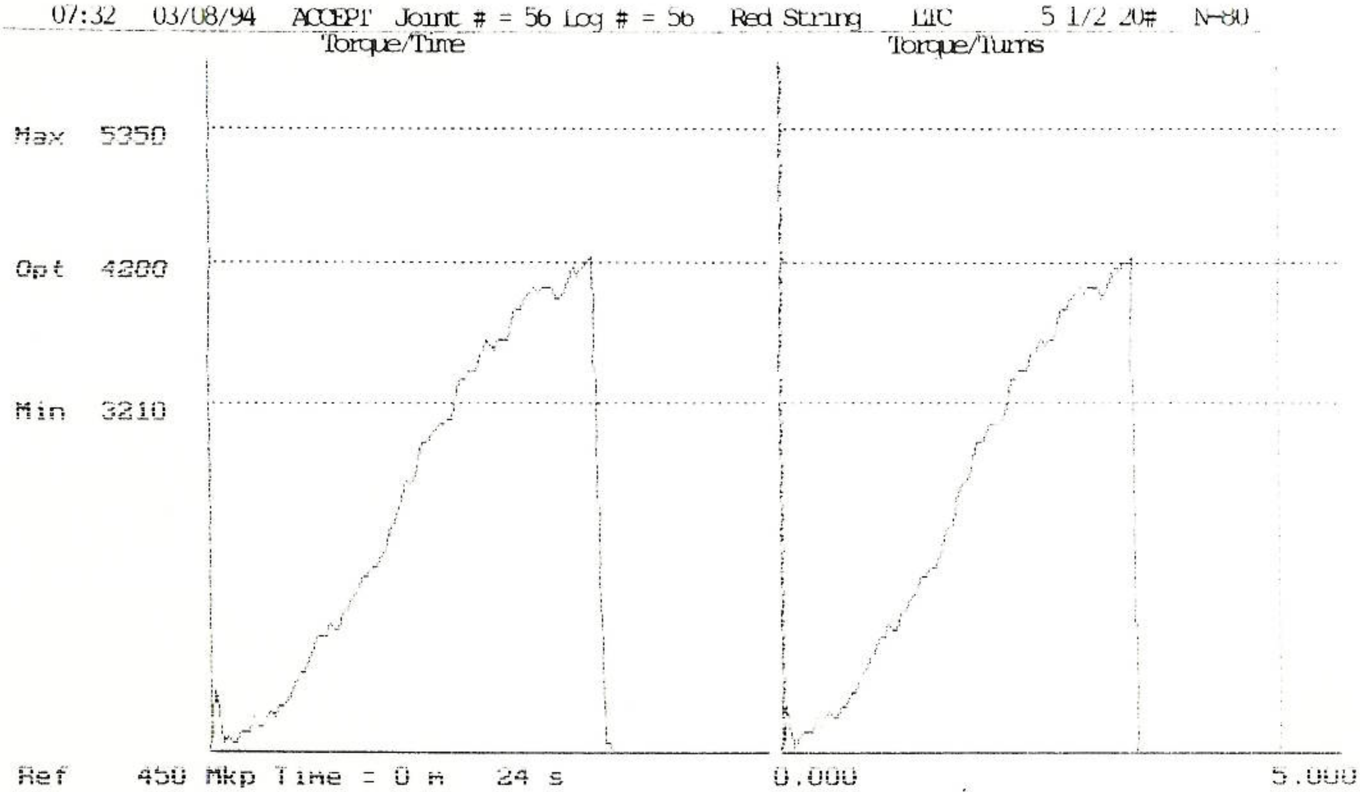
07:29 03/08/94 ACCEPT Joint # = 55 Log # = 55 Red String LTC 5 1/2 20# N-80



Applied Torque = 4285 Top Turns = 4.319

Comments:OK TU

07:32 03/08/94 ACCEPT Joint # = 56 Log # = 56 Red String LTC 5 1/2 20# N-80

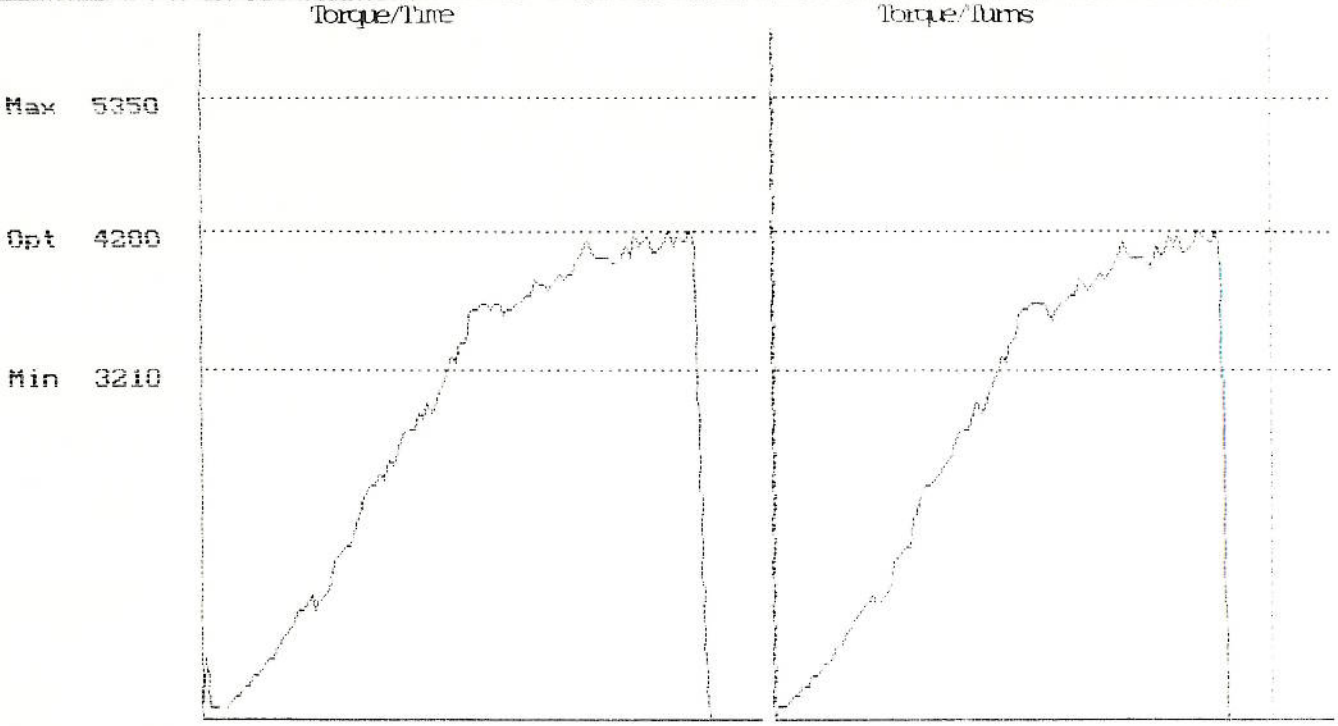


Applied Torque = 4305 Top Turns = 3.512

Comments:OK TU

WEATHERFORD JAM SERVICES

07:35 03/08/94 ACCEPT Joint # = 57 Log # = 57 Red String LTC 5 1/2 20# N-80

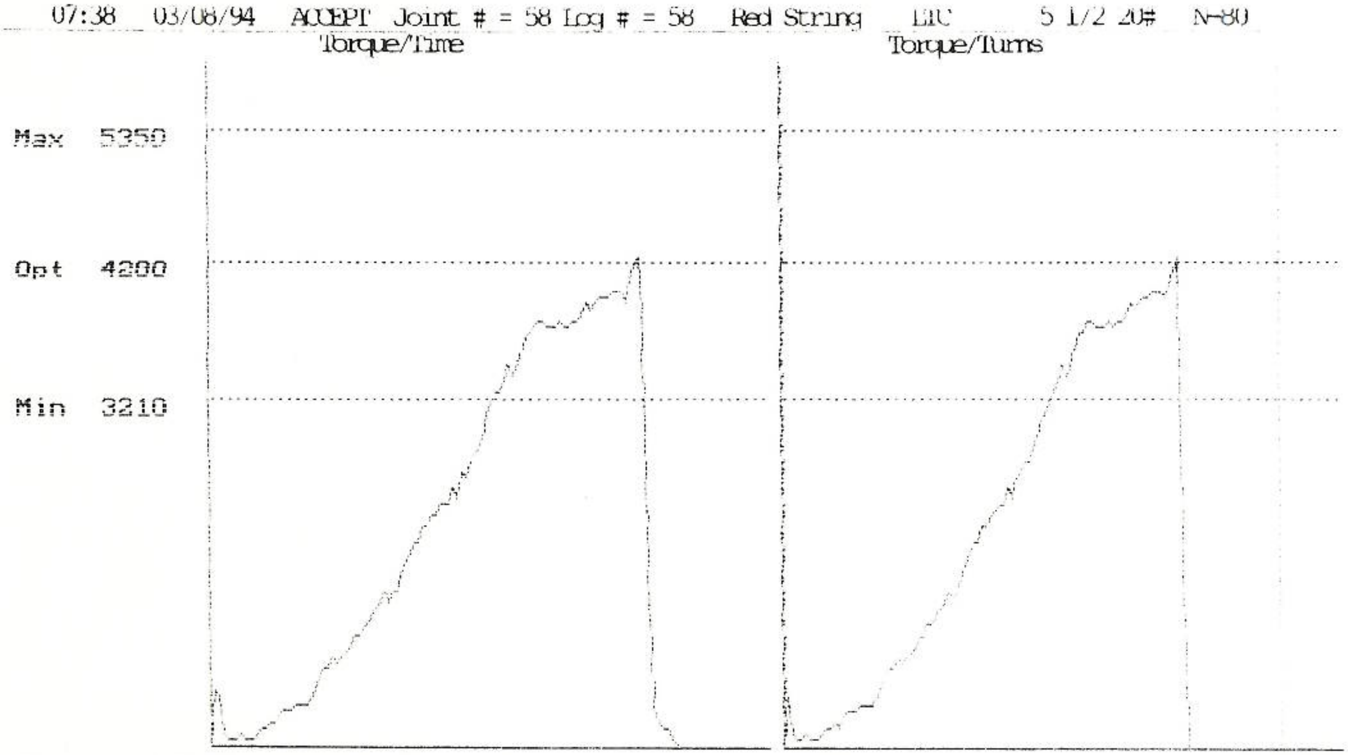


Ref 450 Mkp Time = 0 m 31 s 0.000 5.000

Applied Torque = 4292 Top Turns = 4.484

Comments:OK TU

07:38 03/08/94 ACCEPT Joint # = 58 Log # = 58 Red String LTC 5 1/2 20# N-80



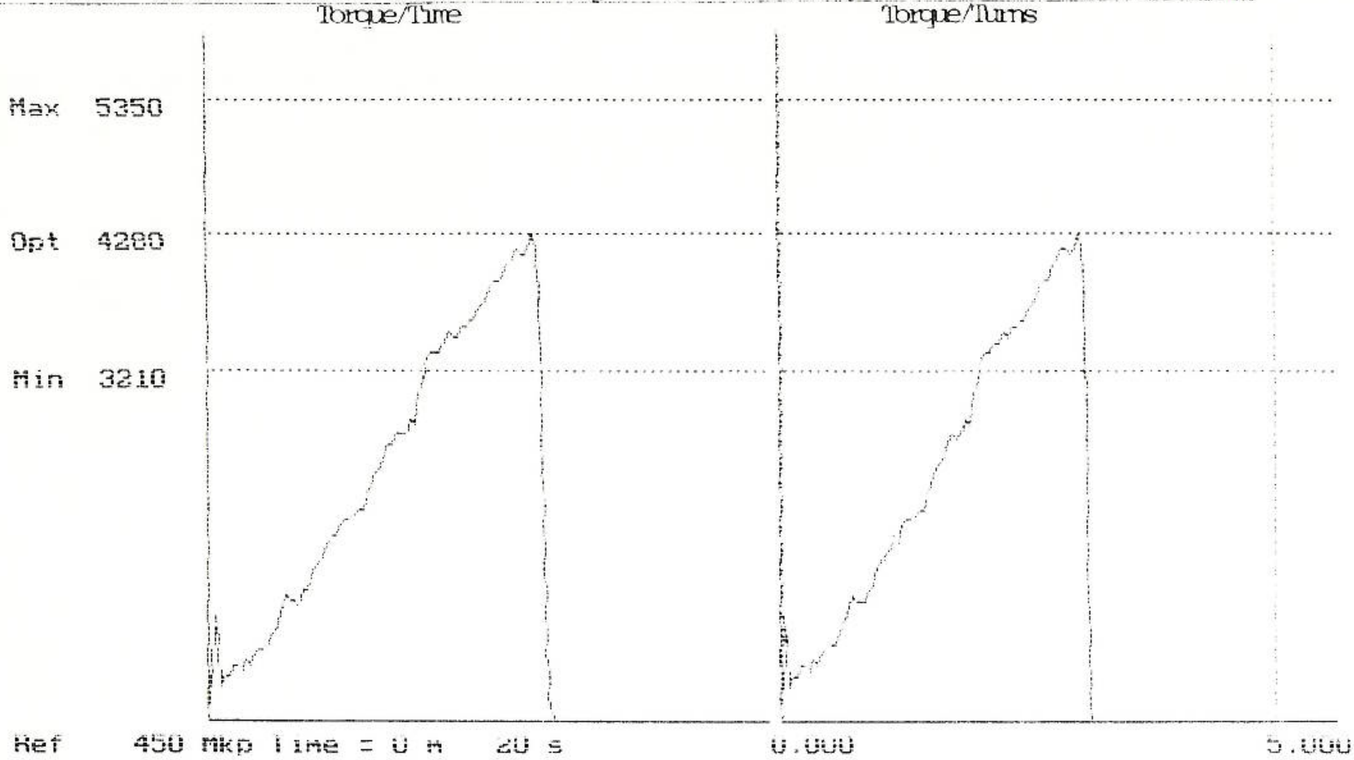
Ref 450 Mkp Time = 0 m 28 s 0.000 5.000

Applied Torque = 4325 Top Turns = 4.006

Comments:OK TU

WEATHERFORD JAM SERVICES

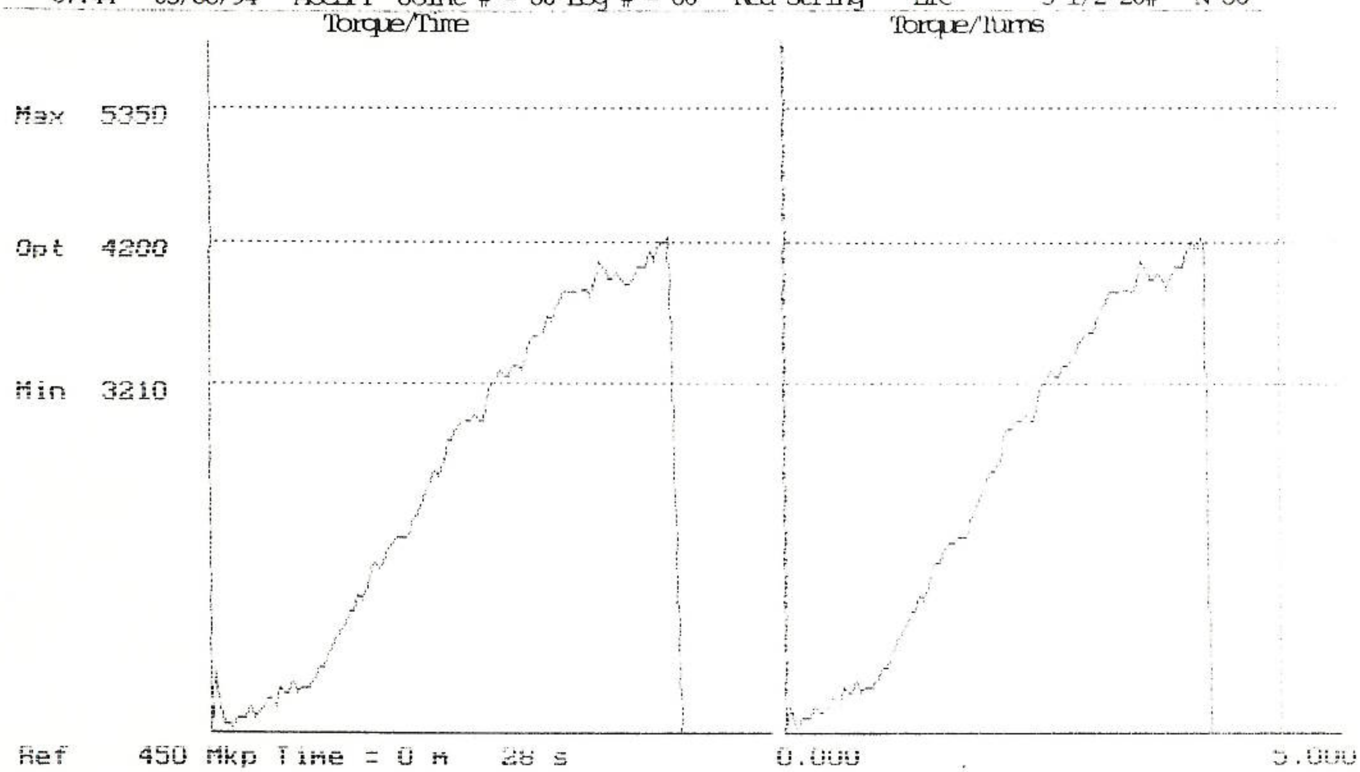
07:41 03/08/94 ACCEPT Joint # = 59 Log # = 59 Red String LTC 5 1/2 20# N-80



Applied Torque = 4285 Top Turns = 3.061

Comments:OK TU

07:44 03/08/94 ACCEPT Joint # = 60 Log # = 60 Red String LTC 5 1/2 20# N-80

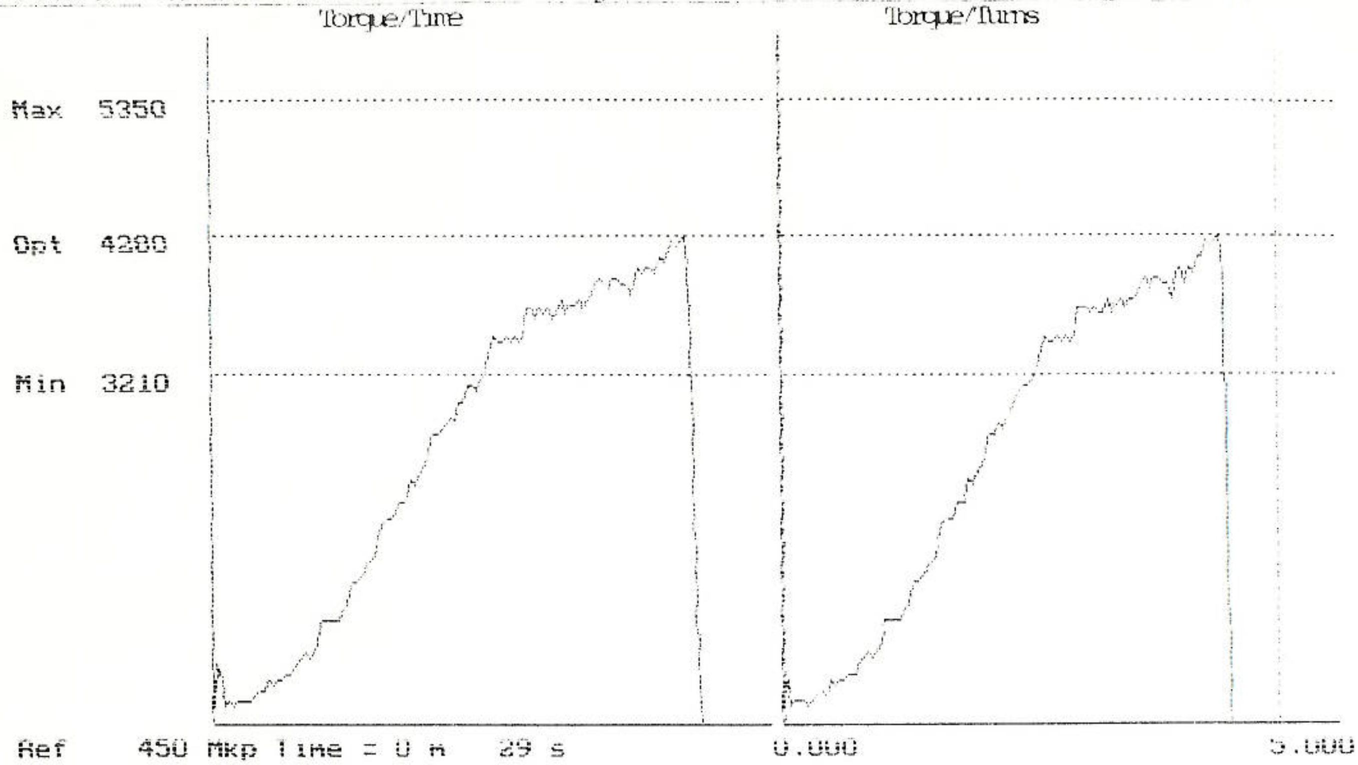


Applied Torque = 4332 Top Turns = 4.229

Comments:OK TU

WEATHERFORD JAM SERVICES

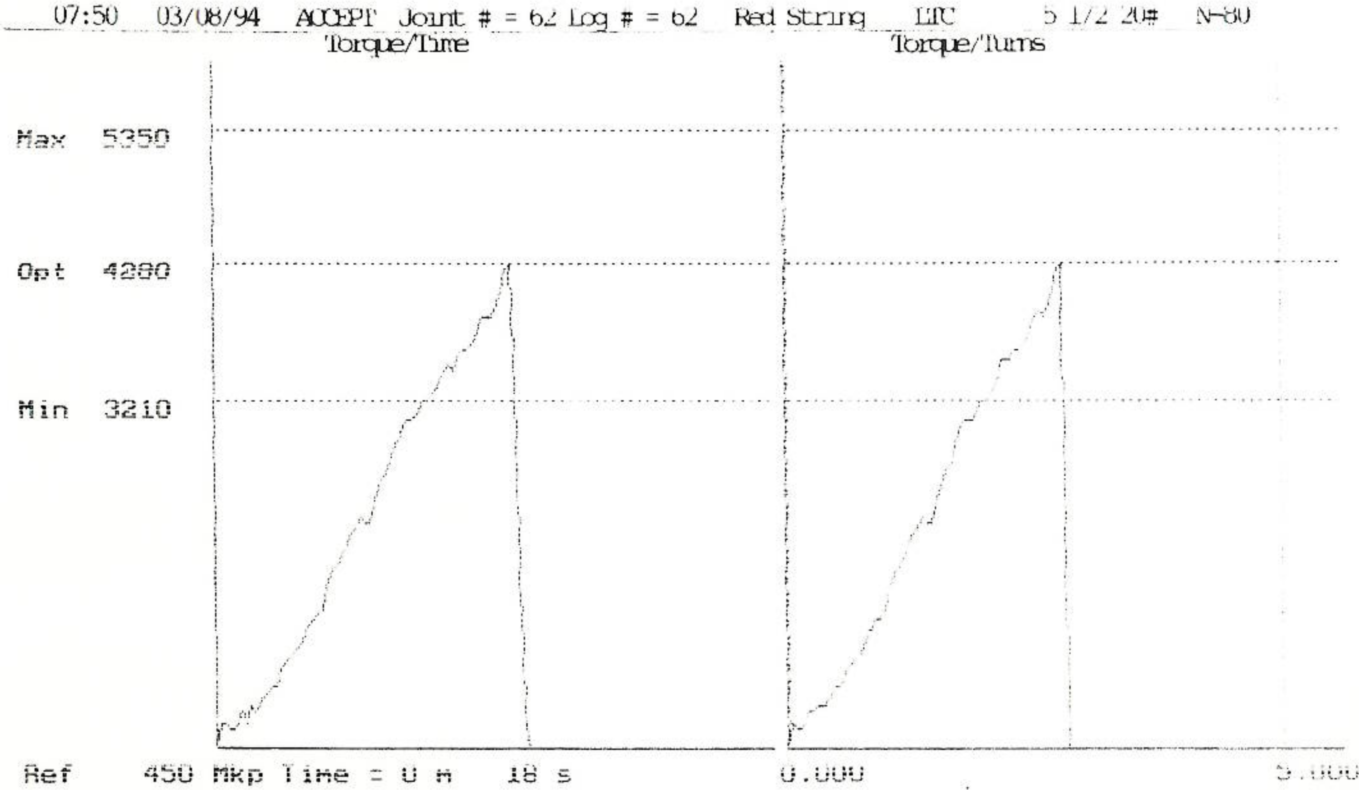
07:47 03/08/94 ACCEPT Joint # = 61 Log # = 61 Red String LTC 5 1/2 20# N-80



Applied Torque = 4292 Top Turns = 4.431

Comments:OK TU

07:50 03/08/94 ACCEPT Joint # = 62 Log # = 62 Red String LTC 5 1/2 20# N-80



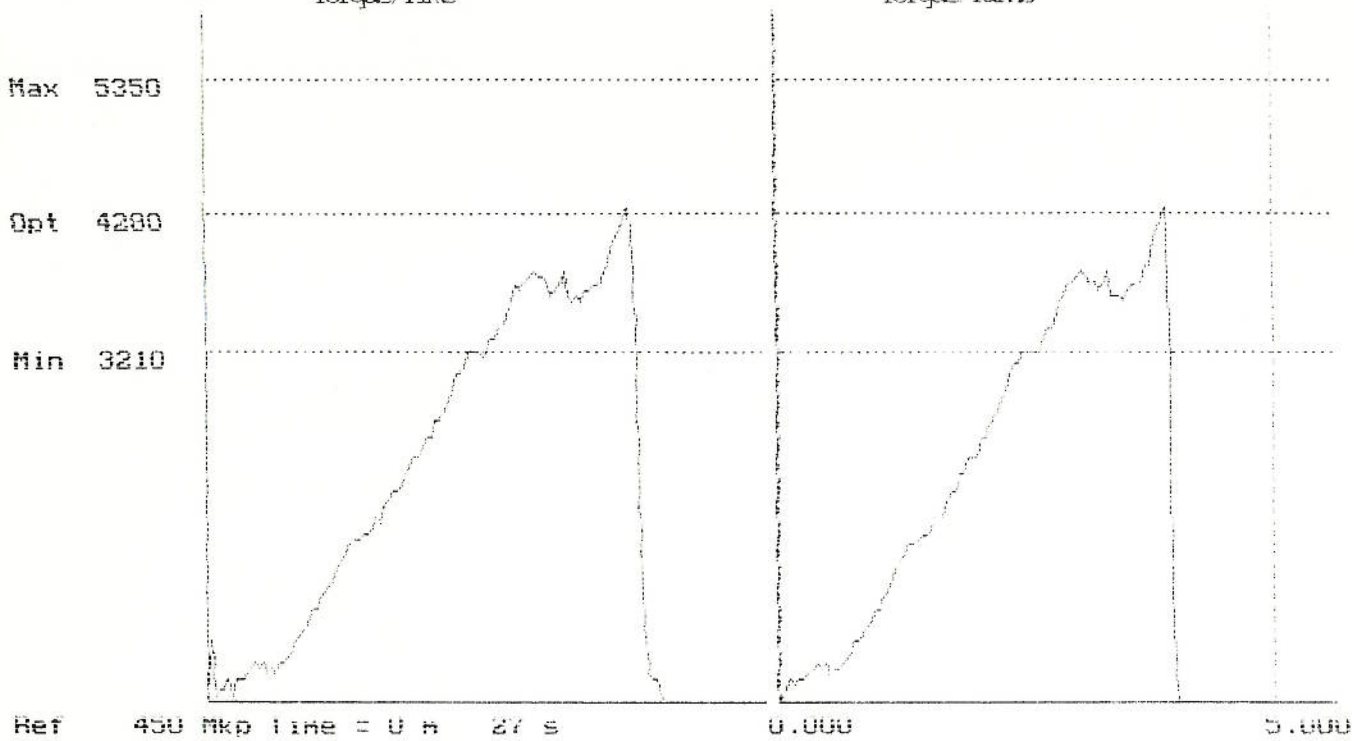
Applied Torque = 4272 Top Turns = 2.785

Comments:OK TU

WEATHERFORD JAM SERVICES

07:53 03/08/94 ACCEPT Joint # = 63 Log # = 63 Red String LTC 5 1/2 20# N-80

Torque/Time Torque/Turns

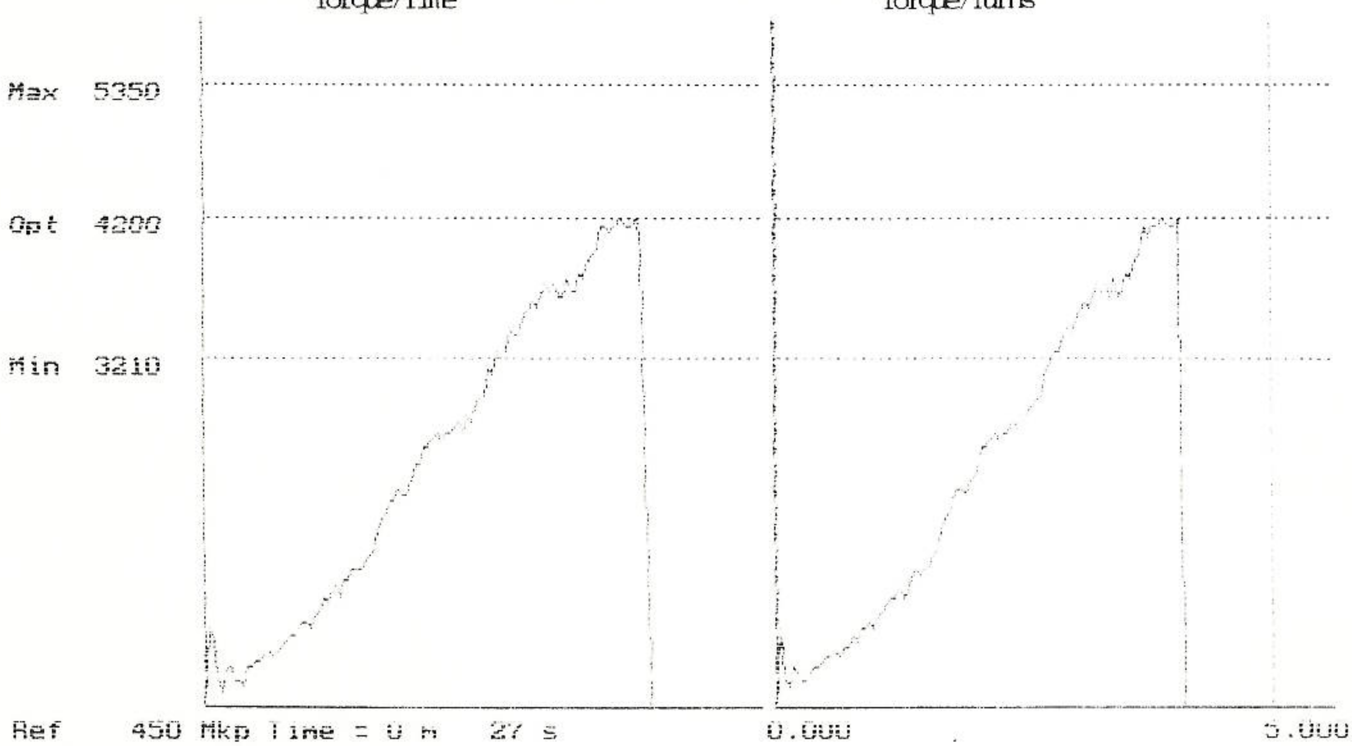


Applied Torque = 4318 Top Turns = 3.959

Comments:OK TU

07:56 03/08/94 ACCEPT Joint # = 64 Log # = 64 Red String LTC 5 1/2 20# N-80

Torque/Time Torque/Turns

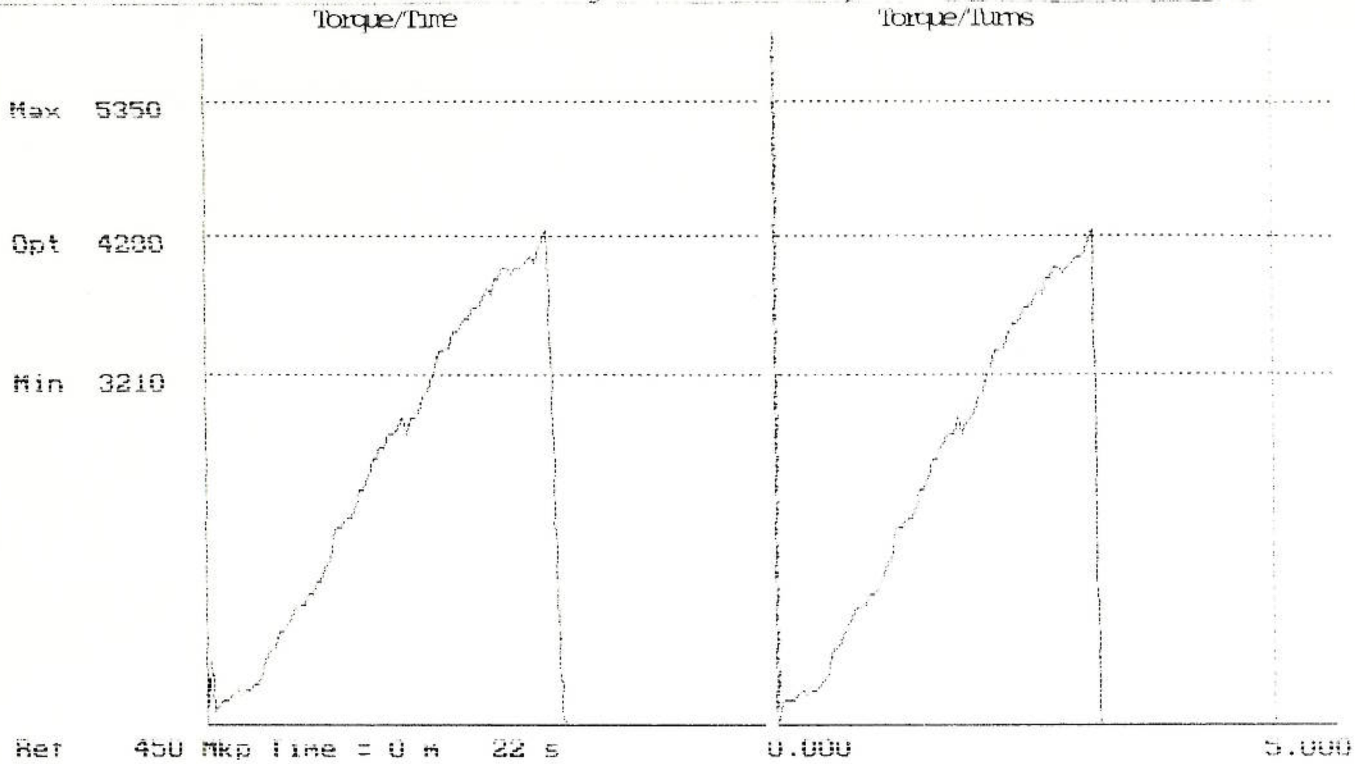


Applied Torque = 4285 Top Turns = 4.081

Comments:OK TU

WEATHERFORD JAM SERVICES

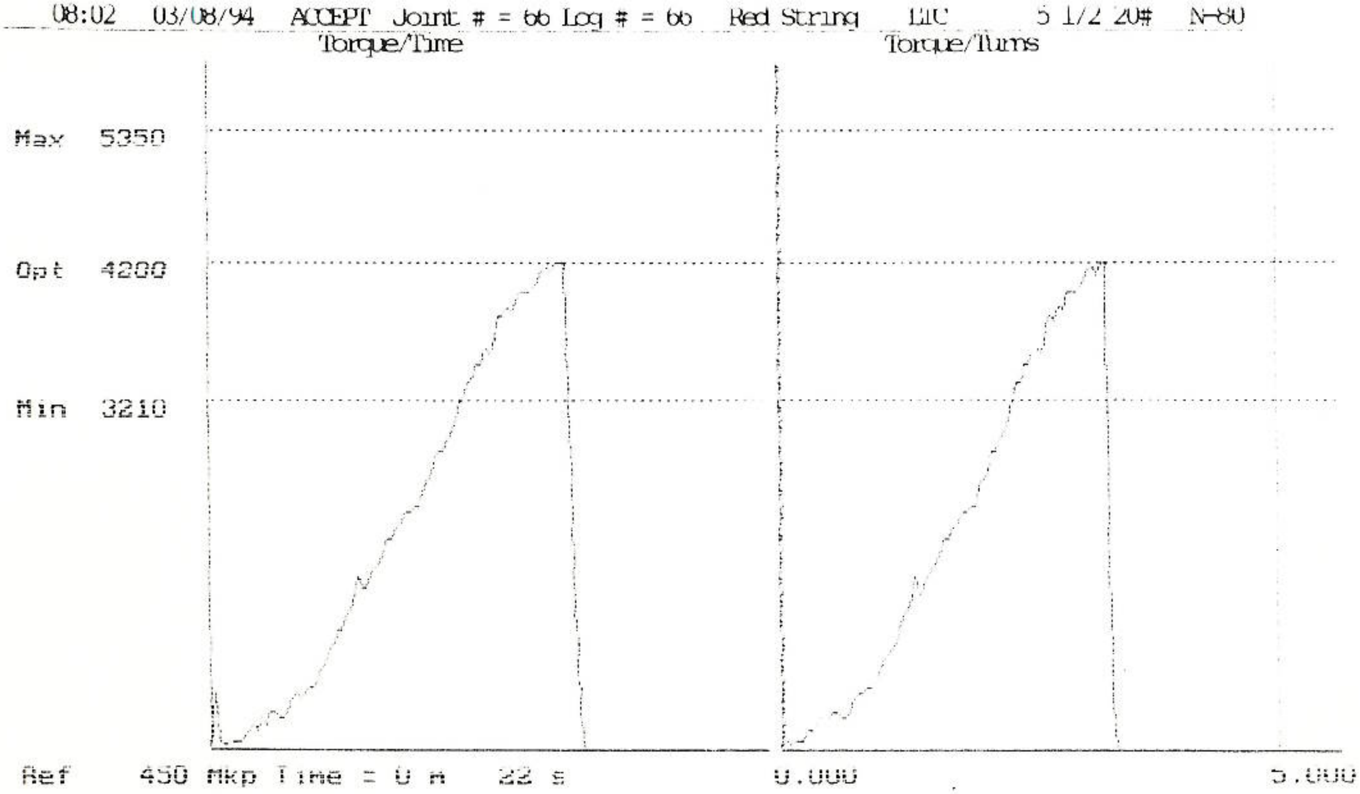
07:59 03/08/94 ACCEPT Joint # = 65 Log # = 65 Red String LTC 5 1/2 20# N-80



Applied Torque = 4328 Top Turns = 3.205

Comments:OK TU

08:02 03/08/94 ACCEPT Joint # = 66 Log # = 66 Red String LTC 5 1/2 20# N-80

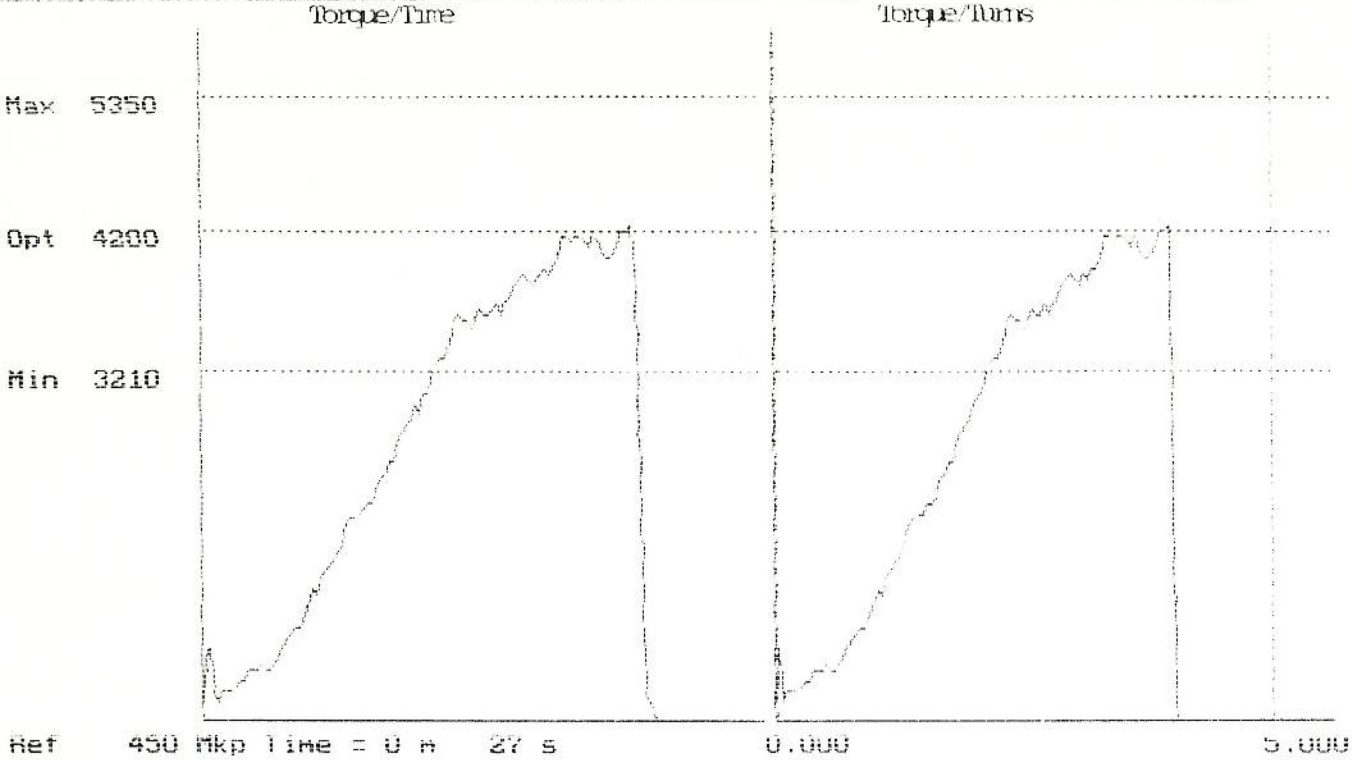


Applied Torque = 4292 Top Turns = 3.311

Comments:OK TU

WEATHERFORD JAM SERVICES

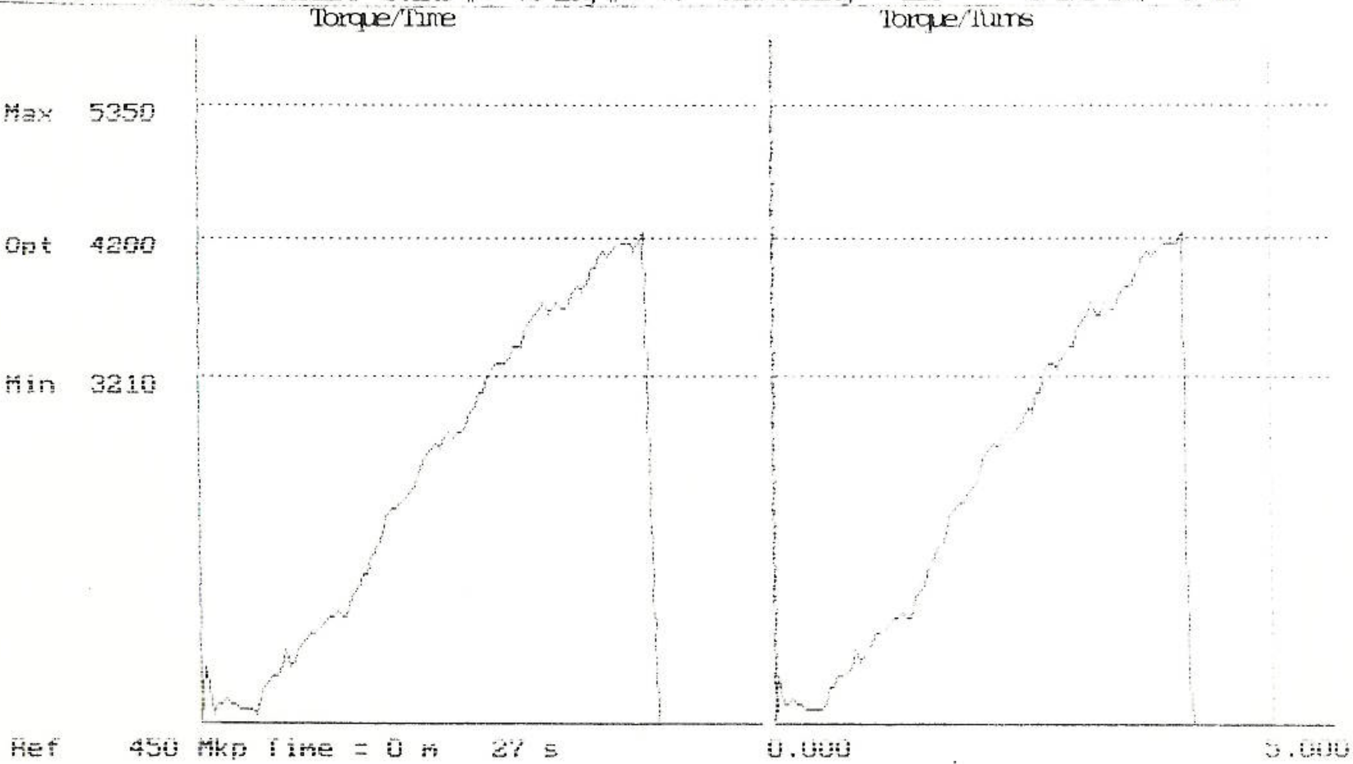
08:12 03/08/94 ACCEPT Joint # = 69 Log # = 69 Red String LTC 5 1/2 20# N-80



Applied Torque = 4298 Top Turns = 3.985

Comments:OK TU

08:15 03/08/94 ACCEPT Joint # = 70 Log # = 70 Red String LTC 5 1/2 20# N-80

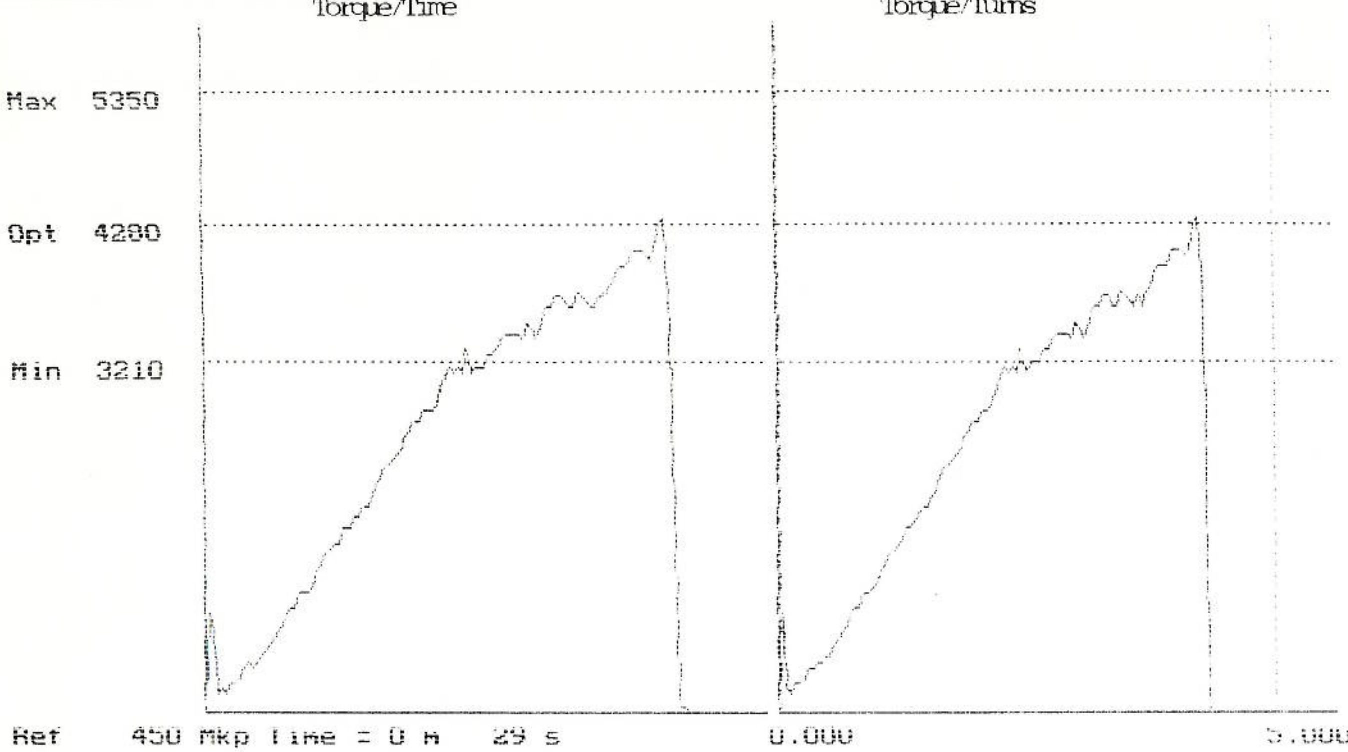


Applied Torque = 4298 Top Turns = 4.128

Comments:OK TU

WEATHERFORD JAM SERVICES

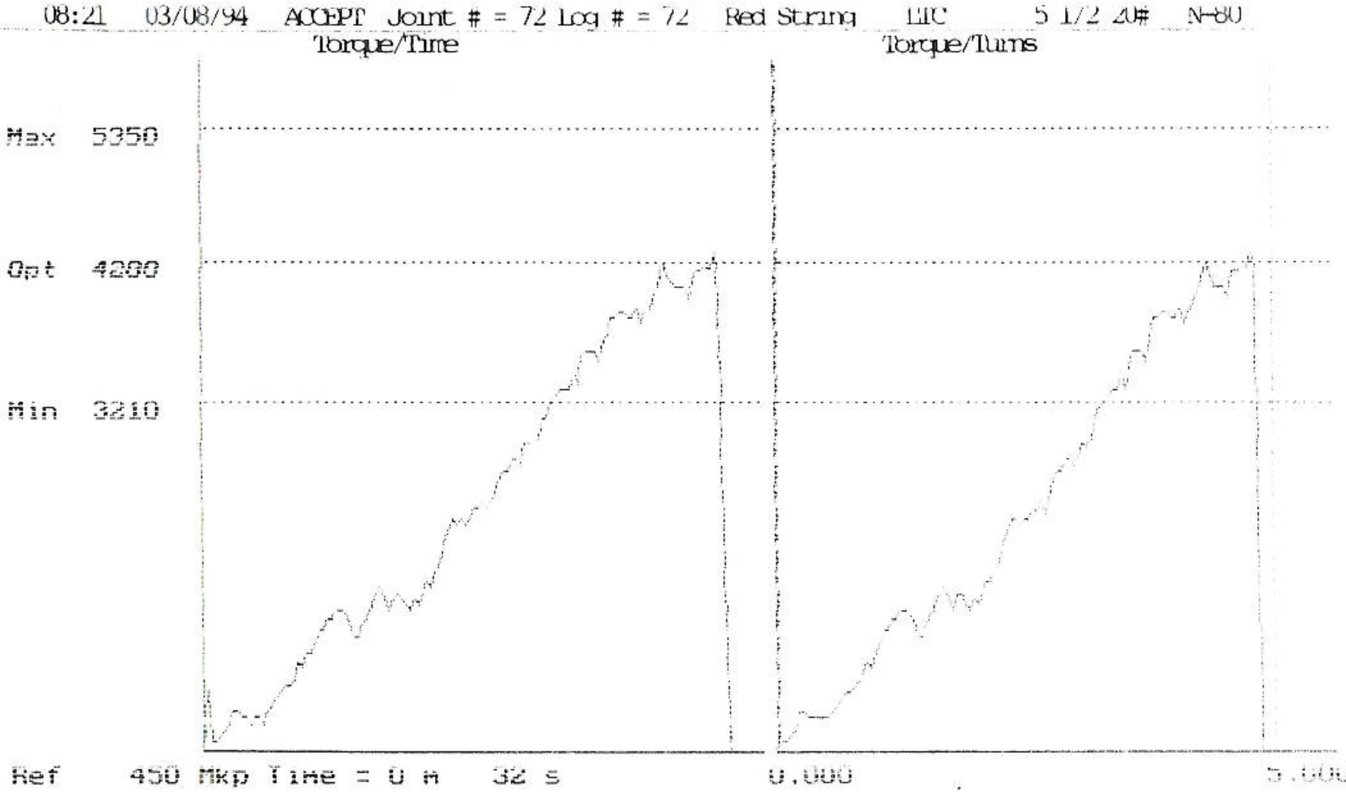
08:18 03/08/94 ACCEPT Joint # = 71 Log # = 71 Red String LTC 5 1/2 20# N-80



Applied Torque = 4298 Top Turns = 4.266

Comments:OK TU

08:21 03/08/94 ACCEPT Joint # = 72 Log # = 72 Red String LTC 5 1/2 20# N-80

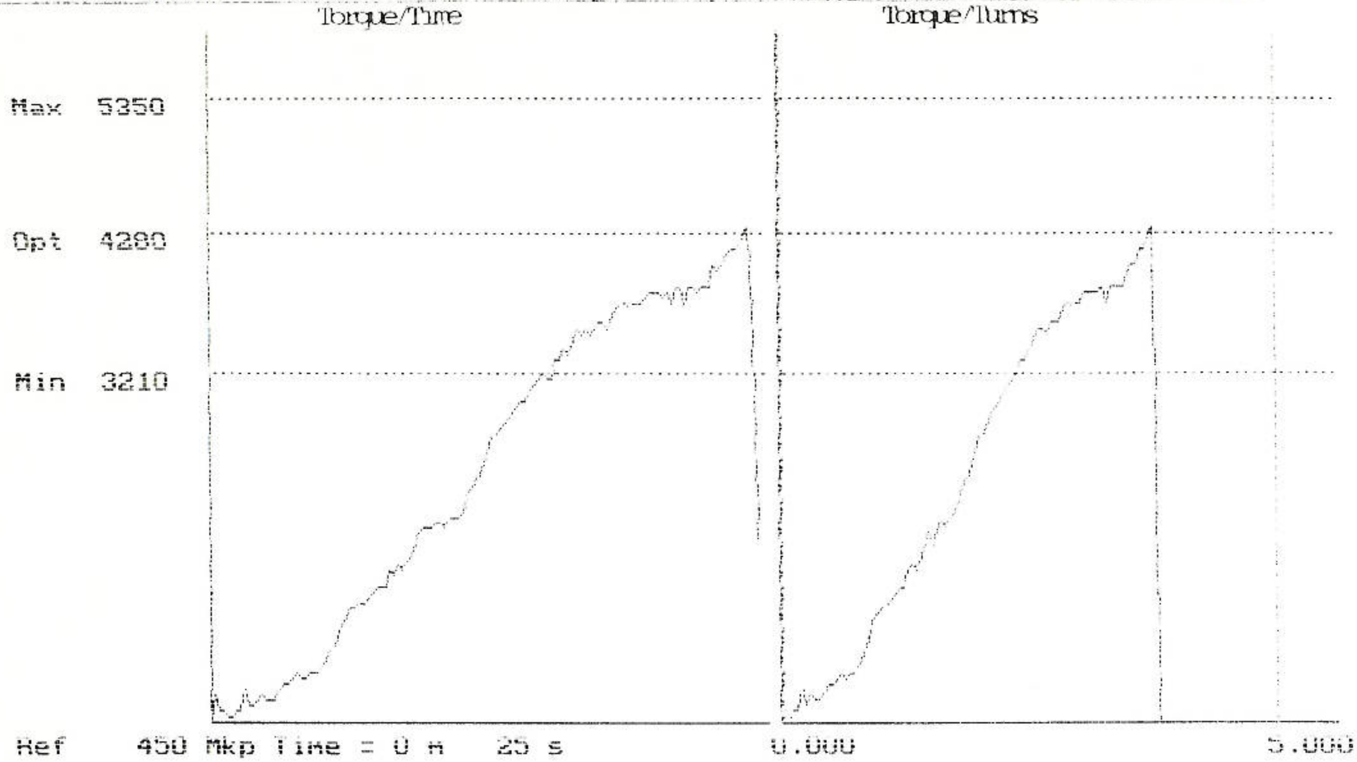


Applied Torque = 4352 Top Turns = 4.787

Comments:OK TU (ELEVATOR PULLING ON PIPE)

WEATHERFORD JAM SERVICES

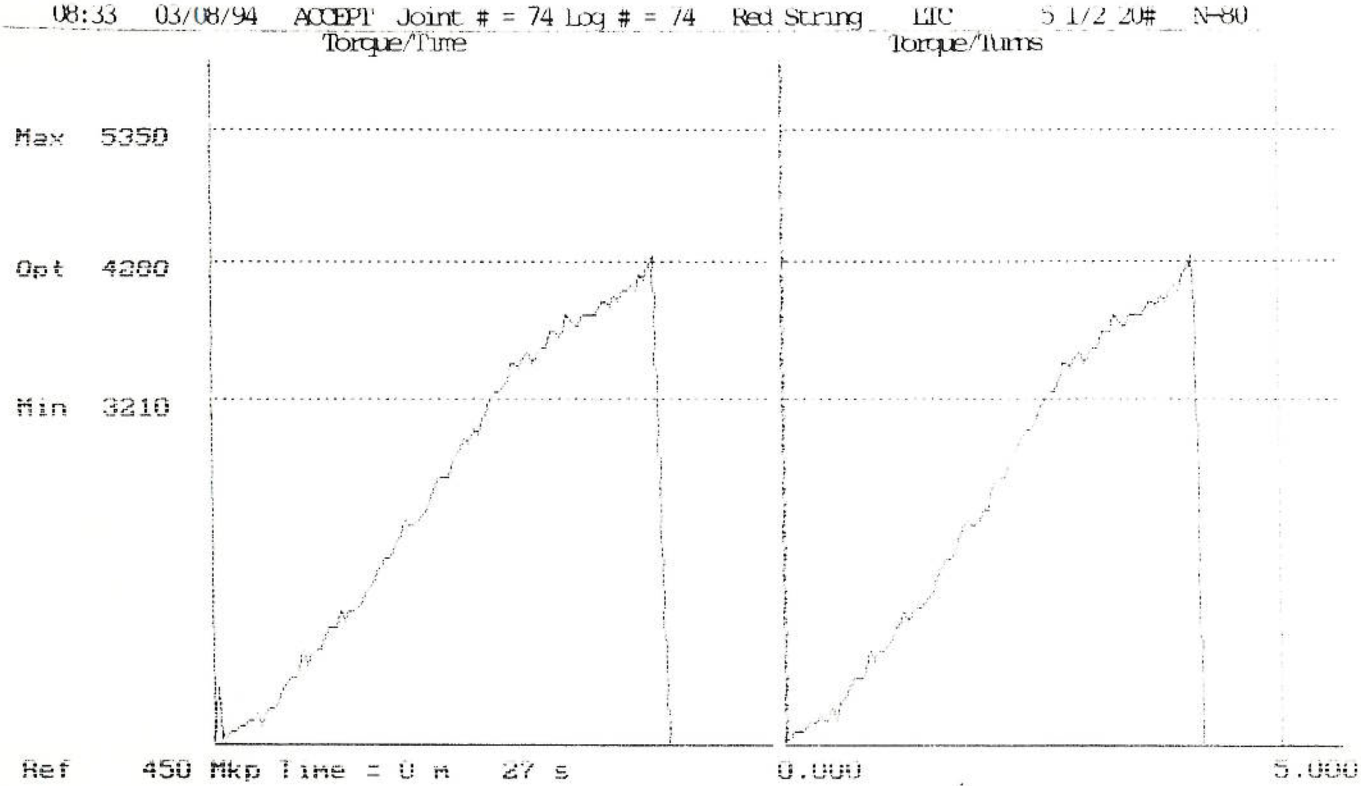
08:30 03/08/94 ACCEPT Joint # = 73 Log # = 73 Red String LTC 5 1/2 20# N-80



Applied Torque = 4314 Top Turns = 3.769

Comments:OK BV

08:33 03/08/94 ACCEPT Joint # = 74 Log # = 74 Red String LTC 5 1/2 20# N-80

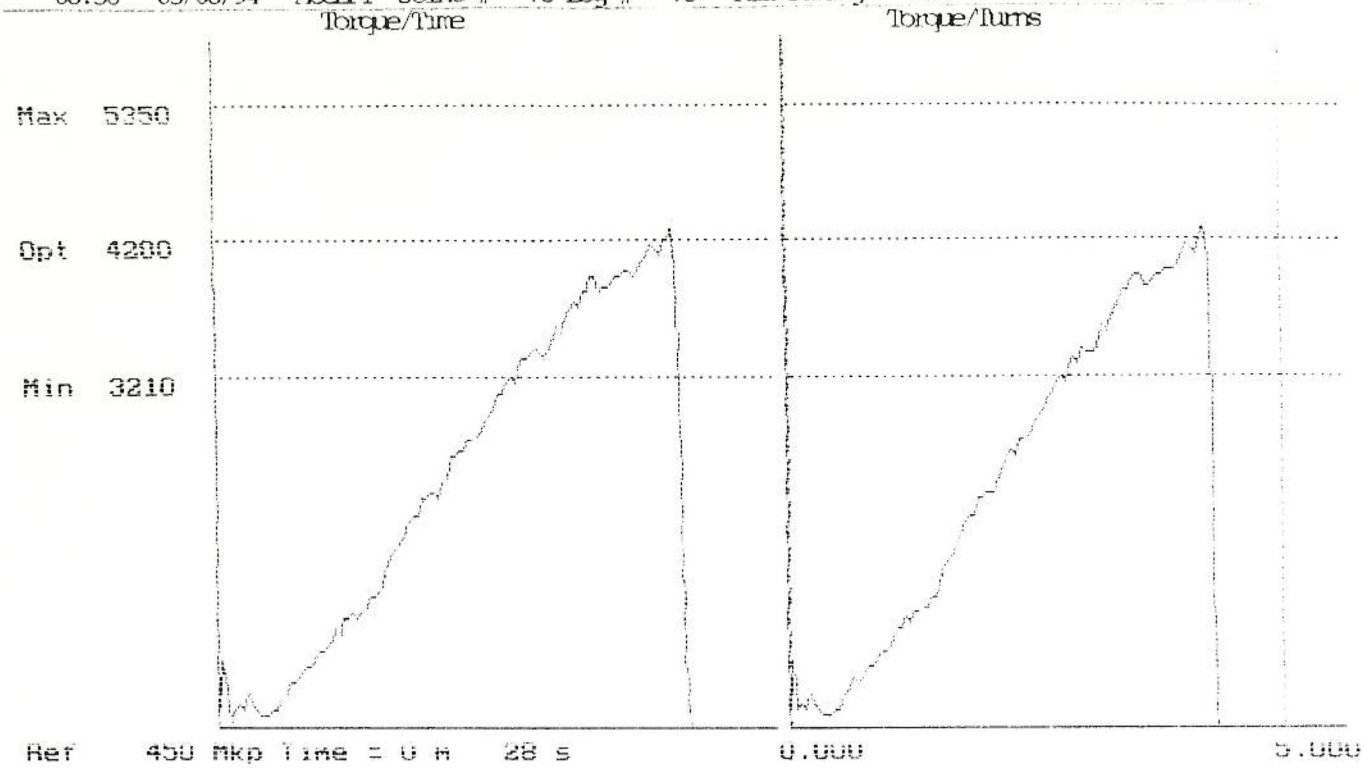


Applied Torque = 4305 Top Turns = 4.133

Comments:OK TU

WEATHERFORD JAM SERVICES

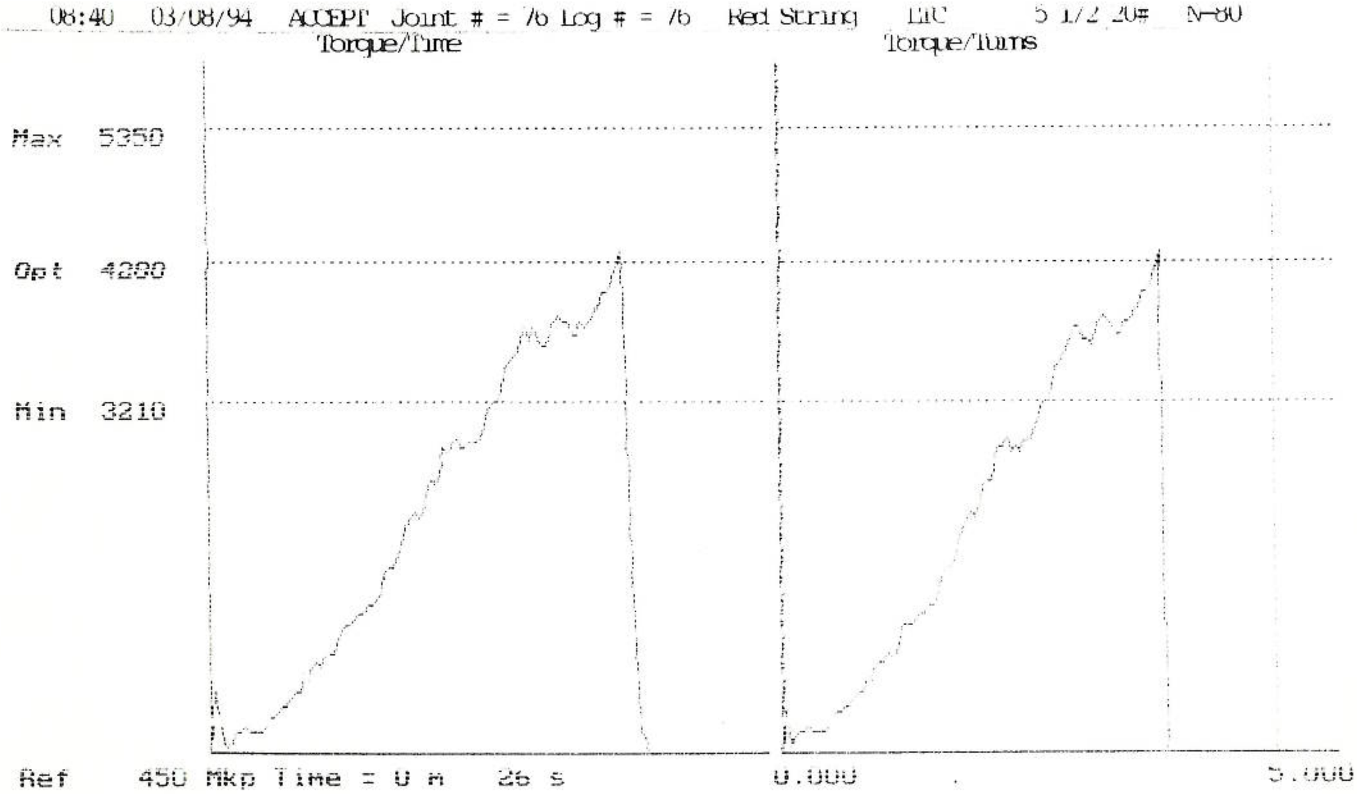
08:36 03/08/94 ACCEPT Joint # = 75 Log # = 75 Red String LTC 5 1/2 20# N-80



Applied Torque = 4385 Top Turns = 4.268

Comments:OK TU

08:40 03/08/94 ACCEPT Joint # = 76 Log # = 76 Red String LTC 5 1/2 20# N-80

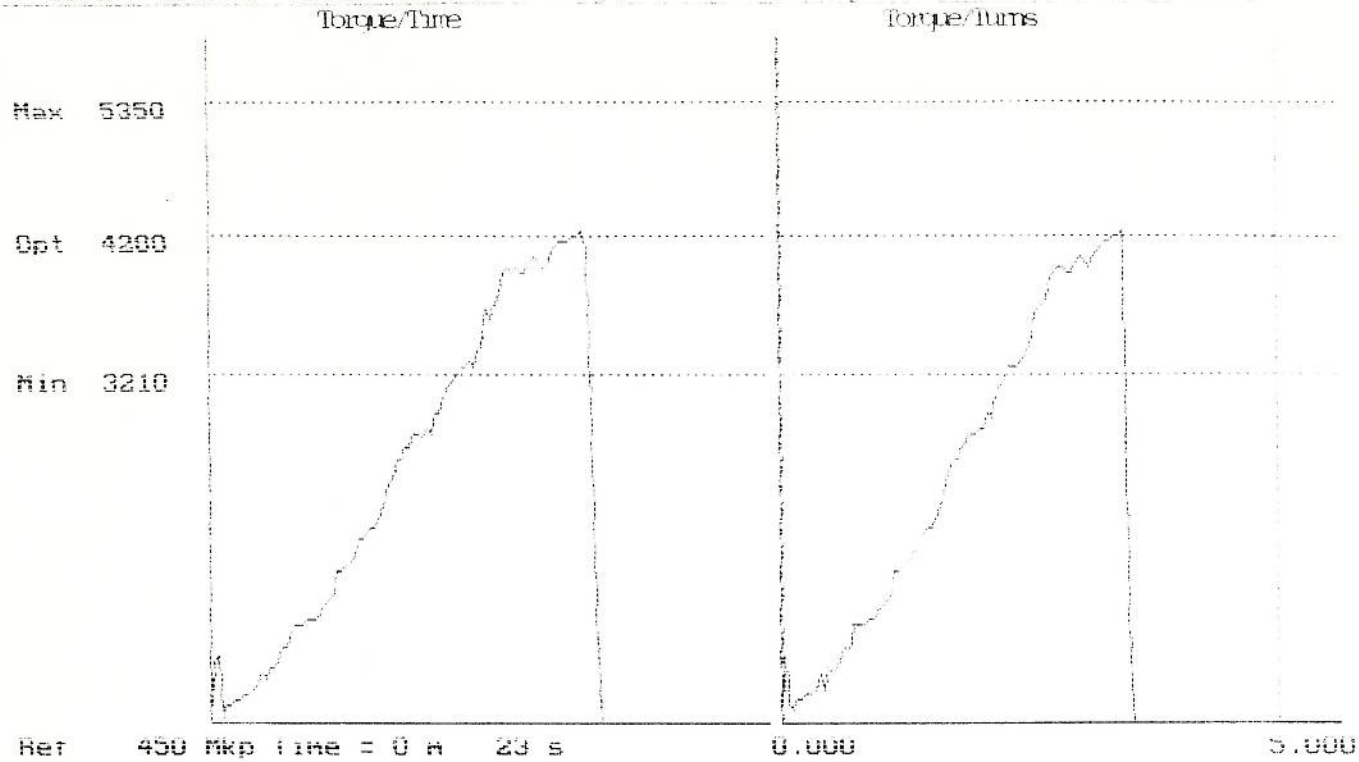


Applied Torque = 4365 Top Turns = 3.865

Comments:OK TU

WEATHERFORD JAM SERVICES

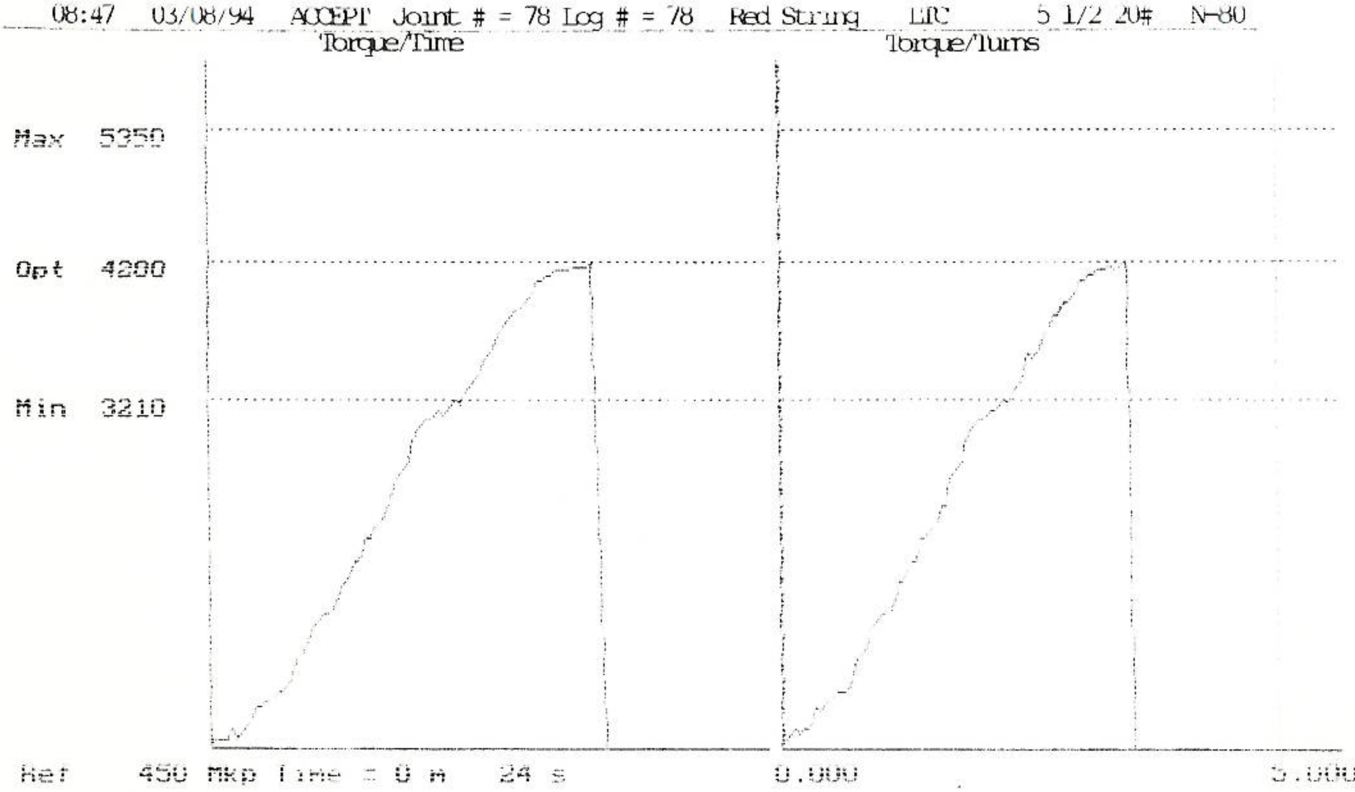
08:43 03/08/94 ACCEPT Joint # = 77 Log # = 77 Red String LTC 5 1/2 20# N-80



Applied Torque = 4305 Top Turns = 3.484

Comments:OK TU

08:47 03/08/94 ACCEPT Joint # = 78 Log # = 78 Red String LTC 5 1/2 20# N-80

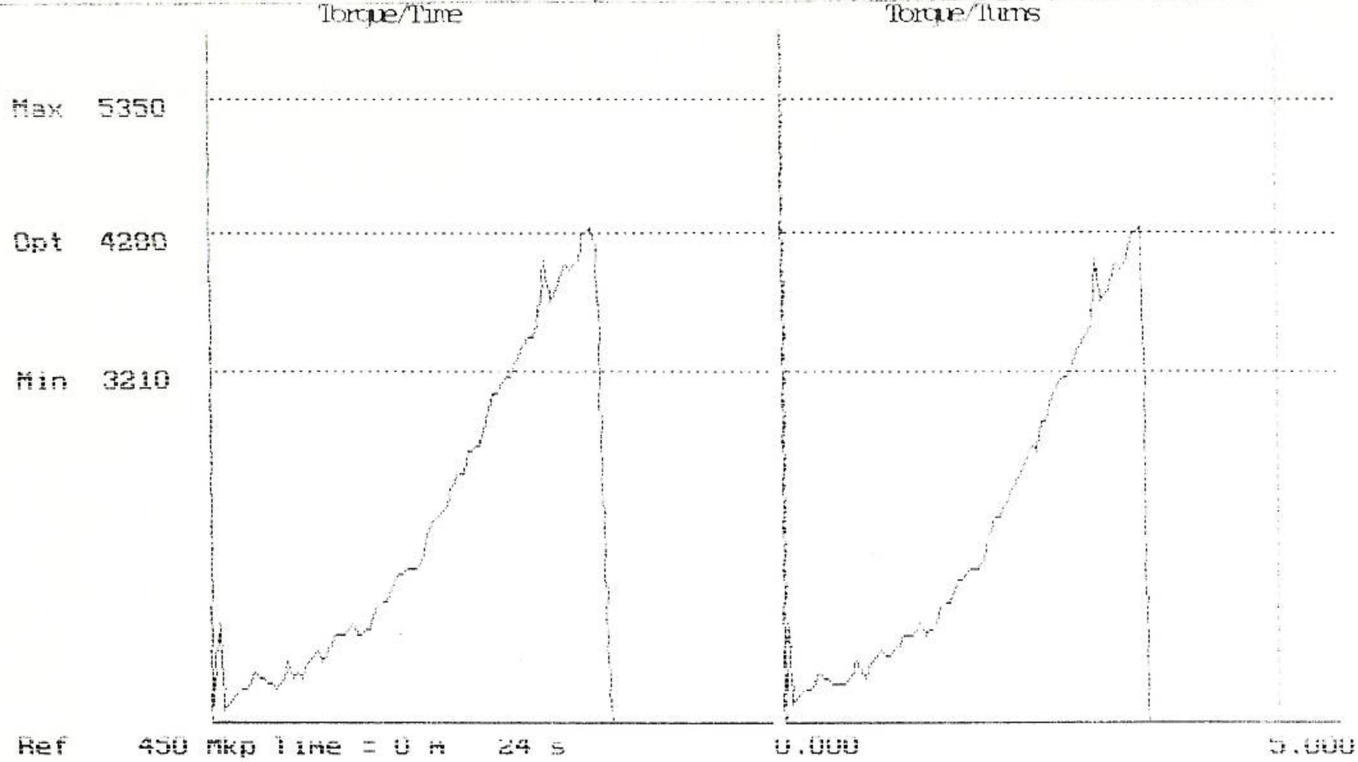


Applied Torque = 4272 Top Turns = 3.496

Comments:OK TU

WEATHERFORD JAM SERVICES

08:51 03/08/94 ACCEPT Joint # = 79 Log # = 79 Red String LTC 5 1/2 20# N-80



Applied Torque = 4305 Top Turns = 3.643

Comments:OK TU

APPENDIX B - MAGNELOG SURVEY ON WDW-49 (WELL NO. 4) WITH WESTERN ATLAS INTERPRETATION LETTER

MAGNELOG (CASING INSPECTION)

Hoechst Celanese Chemical Group, Inc.
Well #4
Bay City Plant
Matagorda County, Texas

Prepared for
ECO Solutions, Inc.
Houston, Texas

ATLAS WIRELINE SERVICES
WESTERN ATLAS INTERNATIONAL

March 5, 1994

Prepared by Freeman Hill, III

DISCLAIMER

In making interpretations of logs, our employees will give Customer the benefit of their best judgement, but since all interpretations are opinions based on inferences from electrical or other measurements, we cannot, and we do not guarantee the accuracy or the correctness of any interpretation. We shall not be liable or responsible for any loss, cost, damages, or expenses whatsoever incurred or sustained by the Customer resulting from any interpretation made/by any of our employees.

Disposal Well Background

The Hoechst Celanese Chemical Group, Inc.'s Injection Well #4, located at the Bay City facility has been used for underground injection. In addition to surface casing string, the well contains 10-3/4" OD casing cemented down to 1,385 ft, and a string of 7-5/8 inch OD casing cemented to 3368 ft.

A logging program consisting of a Magnelog instrument was used to evaluate the integrity of the casing.

The Magnelog is an electromagnetic casing inspection log. The instrument uses a transmitter and a receiver which are located approximately 2 feet apart. The transmitter relays a signal to the receiver, and based on the frequency shift of the original signal, determines the amount of metal present. Thus, when the Phase Curve, located on the right hand side of the log, moves to the right or more phase shift, the greater the metal mass is and vice versa.

On the left side of the log is an Anomaly Indicator Detector (A.I.D.) which responds to internal defects or anomalies if present. All the collars should be seen with this measurement since the collar connections have uneven surfaces.

Magnelog Survey

1. Logged Magnelog from 3300 ft. to 3082 ft.

   Purpose: Repeat section to help determine if the tool is within statistics.

   Analysis: When compared to the main logging pass, ran next, the repeat was satisfactory.

2. Logged Magnelog from well depth of 3300 ft. to surface.

   Purpose: Casing Inspection.

   Analysis: The area between 1392 ft. and 3300 ft. is single string, or just the 7-5/8" casing. The collars are showing up as increases in phase shift. The two increases that are seen are due to the increase in metal at the joint connections. The phase curve does decrease through some joints; however, there is no significant metal loss noted. On some of the joints of pipe (2100 ft.), we notice a decrease in phase shift moving down the joints of pipe. This response is usually related to the manufacturing operations of the pipe.

   Above 1392 ft., there are two strings of pipe. In this area, the Magnelog is less responsive to metal loss and interpretation. When the tool gets used in two strings of pipe, the amount metal and attenuation of the signal, the phase curve can move around, not responding to the pipe accurately. For this reason, I will not comment on this section.

Conclusion:

In my opinion, the Hoecsht Celanese Well #4, located in the Bay City Plant, does not have casing integrity problems that would result in disposed fluids moving into intervals other than the injection zone which would be due to casing corrosion.